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THE BODY SIZE AND FORM OF PRESENT-DAY WHITE ELEMENTARY SCHOOL CHILDREN RESIDING IN WEST-CENTRAL OREGON

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Prior to 1950 the literature on physical growth did not include any research pertaining to the body size or body form of white school children living in the northwestern part of the United States, i.e., in the region north of latitude 42° N and west of longitude 100° W. During the period 1950-52 the first author organized aud supervised a research program on white school children residing in west-central Oregon.[1]

Portions of the findings from the program have been reported in four previous papers (9, 10, 14, 18). Two of these papers dealt with the body size and form of junior high school boys (14, 18), one with the body size of elementary school boys of northwest European ancestry belonging to different socioeconomic categories (9), and one with the size and form of elementary school "Oregon-raised boys of not less than third generation American white stock" (10, p. 39).

This paper, the fifth and last of the series, characterizes 16 traits of size and form on "the general run" of present-day white boys and girls attending public elementary schools in west-central Oregon. Samples were drawn to represent boys at ages 7 and 10 years, and girls at ages 7, 9, and 11 years.

SUBJECTS

The subjects were obtained in the 22 public elementary schools of Eugene, Junction City, and Cottage Grove.[2] Boys were measured in the spring and fall of 1950, girls in the fall of 1951 and spring of 1952. Always the anthropometric examinations were made within 2 months of a child's birthday, e.g., the boys and girls taken to represent age 7 years ranged in exact age from 6 years 10 months 0 days to 7 years 1 month 30 days.

In preparing to work at a particular school, the first step was that of obtaining a list of all white children enrolled who satisfied the sex and age criteria. A letter was sent to the parents of each child listed explaining the

[1] This program was supported by the University of Oregon. Grateful acknowledgment is tendered for a professorial research appointment over the period 1949-52 in the School of Health and Physical Education, and for three grants-in-aid from the Graduate School.

[2] Thanks are due the school superintendents, principals, and teachers for making the subjects available and helping in other ways. Special gratitude is expressed to Madeline Marr, M.D., Director of Health Services for the Eugene School District.

study and requesting consent to the child's participation. For all schools and both sexes combined, 970 letters went out and approval was secured except in 18 instances.

It was later necessary to reject an additional 11 children on whom complete records could not be obtained satisfactorily due to various kinds of body pathology. It follows that the actual number of subjects is 941. In the five separate age-sex subgroups there are 260 boys age 7 years, 208 boys age 10 years, 168 girls age 7 years, 160 girls age 9 years, and 145 girls age 11 years.

Practically all of the subjects were born in North America; 95 per cent were born west of the Mississippi River; and over 50 per cent had resided continuously in Oregon from birth. More than 90 per cent of the children were of northwest European lineage, while approximately 50 per cent were descendants of immigrants from the British Isles. The scattering of children having south and/or east European ancestors in most instances also had one or more grandparents of northwest European ethnic background.

Measurements

The anthropometric examinations were made during school hours, with the full cooperation of school staff, parents, and children. The necessary instruments—including stature board and square, wood and metal calipers, standard bench, steel tape, and weighing scales—were transported to each school and arranged for convenient use in a well lighted and comfortably heated room. Children were measured individually, wearing only shorts or panties at the time body weight was determined and, in the case of the other measurements, wearing nothing which prevented each instrument from making direct contact with the nude body.

Detailed specification of the anthropometric procedures used in obtaining the different measurements has been presented in an earlier publication (10). Hence, it will suffice here to give a succinct identification of each measurement.

Stature (vertex-soles distance). Erect body height taken with the subject's heels, buttocks, and upper part of back in contact with an upright board.

Stem length (vertex-rump distance). Maximum distance from the vertex to the upper surface of an anthropometric bench on which the subject was oriented in an erect sitting position.

Shoulder width (biacromial diameter). Transverse distance between the most lateral points of the acromion processes, with the shoulders in normal orientation.

Hip width (bi-iliocristal diameter). Transverse distance between the lateralmost projections of the crests of the ilia, applying firm pressure against the overlying tissues.

Chest girth (xiphisternal level). Circumference of the thorax, at the level of the xiphisternal junction, under conditions of normal respiration.

Abdomen girth (umbilical level). Trunk circumference during normal posture at the level of the umbilicus. In instances of umbilical protrusion, the measurement was taken immediately above the umbilicus.

Upper limb length (acromion to dactylion). Greatest distance, on the left side, from the posterior end of the lateral border of the acromion to the distal tip of the middle finger.

Arm girth (level of deltoid insertion). Maximum circumference of the left arm in the region approximately half way between the acromion and olecranon processes.

Lower limb length (infraischia-soles distance). Stature minus stem length, i.e., the maximum vertical distance from the most inferior level of the ischia to the plantar surface of the feet.

Leg girth (calf circumference). Maximum girth of the left leg in the region of the calf.

Body weight (unclothed). Weight with the subject standing in the middle of the platform on beam-type scales and wearing only cotton shorts or rayon panties.

The measurements were taken with exceptional care, and every child was fully measured by two different anthropometrists.[3] In instances where the results obtained by the two anthropometrists were not in close agreement, each took an additional reading. Consequently the ultimate record was based in some cases on two determinations and in other cases on four determinations. The "close agreement" criteria were derived from earlier investigations of reliability (4, 5, 7). Specifically, the two initial values were required to agree within 0.2 kg. for weight, 0.1 cm. for hip width and leg girth, 0.2 cm. for stature and arm girth, and 0.4 cm. for the other dimensions. This degree of collection precision was adopted in order to reduce the errors of measurement to negligible amounts and thereby procure final values of high morphologic validity.

Data

The anthropometric data subjected to analysis consisted of 11 measures of body size and 5 measures of body form for each of the 941 subjects. The 11 size traits have been identified in the foregoing section. It remains to specify the 5 traits of body shape or form. These were derived by calculating ratios from selected pairs of dimensions.

[3] The writers were assisted by nine especially trained persons: helping with the boys' examinations were Stanley Culp, Robert Kane, Everett Peery, Chaley Samples, Paul Sherbina, and Peter Trim; assisting with the girls' examinations were Frances Bascom, Lois Gott, and Merle Sigerseth.

The five varieties of ratio data fall meaningfully into two groups. In one group are three ratios which portray variations in the stockiness of major morphologic segments, i.e., describe body form continua of the slender-to-stocky or girth-in-relation-to-length class. Included here are arm girth/upper limb length, leg girth/lower limb length, chest girth/stem length. The two other ratios pertain to shape relationships between superior and inferior aspects of the trunk, i.e., describe variations in the predominance of upper trunk features over lower trunk features. They are shoulder width/hip width and chest girth/abdomen girth. As is customary practice, all of the figures from ratio computation were multiplied by 100 in order to express each quotient as a percentage.

TABLE 1

CENTRAL TENDENCY AND VARIABILITY VALUES AT 7 AND 10 YEARS OF AGE FOR ELEVEN MEASURES OF BODY SIZE ON A 1950 SAMPLE OF WHITE PUBLIC SCHOOL BOYS IN WEST-CENTRAL OREGON

Dimension	*Mean*	*S.E.*$_M$	*S.D.*	PERCENTILES 5	10	30	70	90	95
SEVEN YEARS: *N* = 260									
Stature (cm.)	122.2	.30	4.77	115.3	116.5	119.4	125.1	128.7	130.9
Stem length	67.5	.16	2.50	63.6	64.2	66.1	68.9	70.8	71.9
Shoulder width	26.9	.08	1.21	24.9	25.3	26.3	27.6	28.5	28.9
Hip width	19.3	.06	1.00	17.7	18.1	18.8	19.8	20.7	21.2
Chest girth	58.2	.17	2.74	54.2	55.0	56.8	59.4	61.7	62.8
Abdomen girth	56.2	.20	3.19	51.7	52.4	54.2	57.4	60.0	61.9
Upper limb length ..	51.6	.16	2.50	47.8	48.5	50.2	52.7	55.1	56.0
Arm girth	18.4	.08	1.34	16.4	16.8	17.5	19.0	20.0	20.6
Lower limb length .	54.7	.18	2.84	50.4	50.9	53.0	56.1	58.4	59.4
Leg girth	24.7	.09	1.51	22.4	22.9	23.8	25.3	26.6	27.3
Weight (kg.)	23.9	.19	3.09	19.7	20.3	22.1	25.0	27.4	28.7
TEN YEARS: *N* = 208									
Stature (cm.)	138.8	.37	5.31	129.8	131.7	136.1	141.6	145.5	147.7
Stem length	73.9	.19	2.72	69.6	70.5	72.4	75.4	77.4	78.7
Shoulder width	30.2	.10	1.49	27.9	28.4	29.3	30.9	31.8	32.5
Hip width	21.6	.08	1.15	19.7	20.2	20.9	22.1	23.1	23.5
Chest girth	64.4	.27	3.85	59.2	60.2	62.4	65.6	69.3	70.9
Abdomen girth	62.2	.35	4.97	56.3	57.1	59.3	63.6	68.0	71.2
Upper limb length ..	59.5	.19	2.80	54.9	56.1	57.8	61.1	62.8	64.2
Arm girth	20.5	.14	2.06	18.0	18.4	19.1	21.2	22.9	24.3
Lower limb length .	64.9	.23	3.36	59.2	60.1	63.3	66.6	69.1	70.2
Leg girth	27.8	.14	1.98	24.9	25.4	26.7	28.7	30.5	31.6
Weight (kg.)	32.9	.35	5.02	25.8	27.3	29.7	34.5	39.3	42.5

S.E.$_M$ = standard error of the mean.
S.D. = standard deviation.

TABLE 2

CENTRAL TENDENCY AND VARIABILITY VALUES AT 7, 9, AND 11 YEARS OF AGE FOR ELEVEN MEASURES OF BODY SIZE ON A 1951-52 SAMPLE OF WHITE PUBLIC SCHOOL GIRLS IN WEST-CENTRAL OREGON

Dimension	*Mean*	*S.E.M*	*S.D.*	PERCENTILES 5	10	30	70	90	95
SEVEN YEARS: *N* = 168									
Stature (cm.)	121.4	.40	5.11	113.0	114.7	118.4	124.4	128.1	129.9
Stem length	67.0	.21	2.69	62.4	63.5	65.5	68.6	70.4	71.3
Shoulder width	27.0	.09	1.25	24.9	25.3	26.4	27.7	28.6	29.0
Hip width	19.3	.10	1.23	17.2	17.8	18.7	19.9	20.9	21.5
Chest girth	58.5	.29	3.76	53.6	54.3	56.3	59.7	63.5	66.1
Abdomen girth	58.1	.44	5.71	51.0	52.2	54.7	59.5	66.7	68.8
Upper limb length ..	50.9	.19	2.42	46.7	47.7	49.4	52.1	54.1	54.7
Arm girth	18.9	.14	1.83	16.5	16.8	17.7	19.9	21.4	22.3
Lower limb length .	54.4	.23	2.97	49.7	50.4	52.8	55.9	58.5	59.8
Leg girth	24.8	.14	1.84	21.8	22.3	23.8	25.9	27.2	27.7
Weight (kg.)	23.7	.29	3.72	18.7	19.5	21.2	25.4	28.5	30.8
NINE YEARS: *N* = 160									
Stature (cm.)	132.7	.46	5.76	123.1	125.2	130.0	135.8	139.4	142.6
Stem length	71.7	.22	2.73	66.9	67.9	70.1	73.3	75.2	75.8
Shoulder width	29.2	.11	1.41	27.0	27.5	28.5	29.9	31.0	31.5
Hip width	21.1	.11	1.33	19.0	19.4	20.3	21.7	22.9	23.4
Chest girth	62.9	.33	4.22	56.5	58.0	60.6	64.7	68.4	70.2
Abdomen girth	62.5	.51	6.44	54.0	55.2	59.0	64.5	71.5	74.6
Upper limb length ..	56.3	.22	2.73	51.9	52.9	54.9	57.6	59.5	60.9
Arm girth	20.5	.18	2.33	17.5	17.9	19.1	21.8	23.7	24.9
Lower limb length .	61.0	.28	3.59	55.1	56.2	59.3	62.5	65.4	66.9
Leg girth	27.1	.17	2.17	23.6	24.2	25.8	28.1	29.8	30.4
Weight (kg.)	29.8	.41	5.17	22.1	23.7	26.8	32.3	36.4	38.9
ELEVEN YEARS: *N* = 145									
Stature (cm.)	144.4	.53	6.30	134.7	136.3	140.5	147.7	152.6	154.9
Stem length	76.4	.28	3.32	70.8	71.7	74.6	78.1	80.7	82.4
Shoulder width	31.6	.13	1.55	29.0	29.4	30.8	32.3	33.5	34.2
Hip width	23.1	.11	1.37	20.6	21.3	22.4	23.7	24.9	25.3
Chest girth	67.5	.42	5.02	59.8	62.2	64.4	69.5	73.8	76.9
Abdomen girth	67.6	.55	6.64	58.2	60.1	63.4	70.4	77.3	80.2
Upper limb length ..	61.7	.25	3.01	56.6	57.7	60.1	63.3	65.5	66.5
Arm girth	22.3	.20	2.37	18.5	19.1	21.0	23.4	25.7	26.6
Lower limb length .	68.0	.31	3.73	62.0	63.1	66.0	69.8	73.2	74.4
Leg girth	29.4	.21	2.47	25.2	26.5	28.1	30.4	32.4	34.1
Weight (kg.)	37.5	.54	6.49	27.6	29.8	33.8	40.3	46.4	49.5

S.E.M = standard error of the mean.
S.D. = standard deviation.

Findings on Body Size: Oregon, 1950-52

Central tendency and variability findings for the 11 measures of body size are presented in Tables 1 and 2, for boys and girls respectively. If each trait had given distributions representing statistically normal surfaces, the two independent approaches to analysis of variability (column 3 and columns 4 to 9) would have been redundant. Actually, however, almost half of the distributions (those for weight and the four girths) showed positive skewness, with the others (the 4 lengths and 2 breadths) approximating statistical normality.[4]

A full discussion of the contents of Tables 1 and 2 could extend easily over several pages. It appears sufficient aid for use of the tables to illustrate the different kinds of information that the reader may extract:

1. *Mean size at the ages studied.* The average 10-year-old white schoolboy residing in west-central Oregon—as estimated from the 1950 sample under study—has a stature of 138.8 ± 0.4 cm. and shoulder width (biacromial diameter) of 30.2 ± 0.1 cm.

2. *Increase in mean size over the periods studied.* Compared with the average 7-year-old white schoolgirl residing in west-central Oregon, the average 11-year-old schoolgirl is taller by approximately 23 cm. and heavier by about 14 kg.

3. *Comparative mean size of different dimensions.* For the sample of schoolgirls drawn to represent age 9 years, the mean girth of arm is less than the mean girth of leg by 6.6 cm., or 24 per cent.

4. *Sex differences in mean size at age 7 years.* The paired series of means obtained on present-day Oregon children age 7 years show that the boys are larger than the girls in stature and length of upper extremities, while the two sexes are similar in hip width and leg girth.

5. *Variability in size at the ages studied.* Of the sample of boys drawn to represent age 10 years, 10 per cent weighed less than 27.3 kg., 20 per cent between 27.3 and 29.7 kg., 40 per cent between 29.7 and 34.5 kg., 20 per cent between 34.5 and 39.3 kg., and 10 per cent more than 39.3 kg.

6. *Change in variability with age.* The standard deviations for each trait increase with age. On girls, for instance, the progression in stature is from 5.1 cm. at 7 years through 5.8 cm. at 9 years to 6.3 cm. at 11 years. Corresponding sigmas for weight approximate 3.7 kg., 5.2 kg., and 6.5 kg.

7. *Comparative variability of different dimensions.* At all of the ages studied, the scatter is greater for abdomen girth than chest girth, and greater for lower limb length than upper limb length. In terms of the coefficient of variation (standard deviation × 100/mean) variability is least for stem length and greatest for body weight.

[4] In this connection see reference 6, pp. 50-51.

8. *Sex differences in variability.* The spread of most distributions is greater for girls than for boys. At age 7 the standard deviations obtained on the girls are appreciably larger than those on the boys, except for the two dimensions, shoulder width and upper limb length.

9. *Overlapping of the distributions for different ages.* The trait distributions show varying amounts of overlapping at successive ages. For shoulder width on girls, 95 per cent of the measures lie below 29.0 cm. at 7 years and only 5 per cent below this value at 11 years; in the case of arm girth on girls, 95 per cent of the measures lie below 22.3 cm. at 7 years and over 50 per cent are still below this value at 11 years.

Findings for Body Size: Comparative

It would be possible to compare selected values from Tables 1 and 2 (particularly the means for stature and weight) with corresponding values on literally scores of groups of white children described in the research literature. Comparisons will be made only with a few groups chosen for their special relevance ethnically, secularly, and geographically.

In the initial selection, the aim was to get as near as possible to a comparison in which ancestry and region were controlled and secular period was the predominant variable. A sample drawn in the fall of 1892 from the public schools of Oakland, California, (1) was selected as best fitted for this purpose. The study was one of several promoted around 1890 by Franz

Table 3

COMPARISON OF THE STATURE AND WEIGHT MEANS FROM TABLES 1 & 2 WITH MEANS FOR WHITE CHILDREN STUDIED ALMOST 60 YEARS EARLIER IN WEST-CENTRAL CALIFORNIA (1)

	AGE-SEX GROUP				
	G7*	B7	G9	B10	G11
California, 1892					
Number of subjects	155	170	232	227	223
Mean stature (cm.)	115.0	115.9	125.2	130.9	136.2
Mean weight (kg.)	20.2†	21.1	24.8	28.3	30.5
Oregon, 1950-52					
Taller in stature by:	6.4	6.3	7.5	7.9	8.2
Heavier in weight by:	3.5	2.8	5.0	4.6	7.0

* G7 symbolizes girls age 7 years; B7, boys age 7 years; etc.

† The subjects were weighed wearing indoor clothing (without shoes). Deductions of 1.5 kg. have been made to approximate adjustment for weight of clothing.

Boas; it was carried out cooperatively by the University of California and Stanford University.

Compared with the Oregon sample of the present study, the Oakland sample is strikingly similar ethnically, less than 500 miles removed geographically, but separated in time by more than half a century. Table 3 shows that like age-sex means from the two samples differ systematically, the 1950-52 Oregon children being markedly taller and heavier than the 1892 California children. Expressed in English units, the obtained differ-

TABLE 4

COMPARISON OF THE STATURE AND WEIGHT MEANS FROM TABLES 1 & 2 WITH MEANS FOR WHITE CHILDREN STUDIED 1937-39 IN WEST-CENTRAL CALIFORNIA (15)

	AGE-SEX GROUP				
	G7*	B7	G9	B10	G11
California, 1937-39					
Number of subjects	254	235	266	285	272
Mean stature (cm.)	121.1	122.1	132.5	138.4	143.9
Mean weight (kg.)	23.6	23.9	29.7	33.0	37.4
Oregon, 1950-52					
Taller in stature by:	0.3	0.1	0.2	0.4	0.5
Heavier in weight by:	0.1	0.0	0.1	—0.1	0.1

* As in Table 3.

ences are: (*a*) for stature, 2.5 inches at 7 years and more than 3.0 inches at 10 and 11 years,[5] and (*b*) for weight, around 7 pounds at 7 years and 10 to 15 pounds at 10 and 11 years.

Selections next were made with the objective of aligning findings on the children of the present study with findings on other children as comparable as have been studied ethnically, secularly, and geographically. Highly comparable investigations do not exist; while samples are accessible that essentially match the Oregon sample from the standpoint of ethnic composition, the closest materials geographically and secularly fall in California and Utah during the quinquennium 1934-39.

The California data are part of a large-scale 1937-39 investigation sponsored by the U.S. Bureau of Home Economics (15). They were amassed

[5] An earlier alignment of Toronto school children for the years 1892 and 1939 (12) gave stature differences of practically the same magnitude. For further information on secular change at the elementary school ages, see reference 8, and compare the California means in Tables 3 and 4.

largely in Alameda and Contra Costa counties (the county in which Oakland is located and one adjacent) and sampled "the general run of white American-born boys and girls in public and private schools, on playgrounds, in camps, and in clubs" (15, p. 2). Means for stature and weight based upon these data are displayed in Table 4. It will be seen that the mean values from sample "west-central California, 1937-39" almost coincide with those from sample "west-central Oregon, 1950-52"; none of the differences is statistically significant.

TABLE 5

COMPARISON OF THE STATURE AND WEIGHT MEANS FROM TABLES 1 & 2 WITH MEANS FOR WHITE CHILDREN STUDIED 1934-39 IN NORTH-CENTRAL UTAH (2, 15)

	AGE-SEX GROUP				
	G7	B7	G9	B10	G11
Utah, 1934-39					
Number of subjects	746	740	996	1052	1012
Mean stature (cm.)	120.6	121.5	131.2	137.0	142.3
Mean weight (kg.)	21.2*	22.1	26.2	29.7	32.7
Oregon, 1950-52					
Taller in stature by:	0.8	0.7	1.5	1.8	2.1
Heavier in weight by:	2.5	1.8	3.6	3.2	4.8

* In one of the pooled studies (2) weight was determined in indoor clothing; reductions for estimated clothing weight were made.

Turning to Utah, there are studies which analyze data collected during 1934-35 (2) and 1937-39 (15) in the north-central section. The earlier materials are on white children attending public schools in Logan, Provo, and Salt Lake City; the later materials on white children residing mainly in Cache and Salt Lake counties (the counties in which Logan and Salt Lake City are located). Both samples are ethnically similar to the Oregon sample in that over 90 per cent of the subjects were descendants of immigrants from the British Isles, Netherlands, Scandinavia, and Germany, while approximately 50 per cent were of British ancestry. Table 5 presents statistics from combining the two samples and subtracting the derived stature and weight means from the means of Tables 1 and 2. All of the differences are consistent in direction, and all except those for stature at age 7 years are significant statistically. At ages 9, 10, and 11 years the obtained differences show the 1950-52 children of west-central Oregon to surpass the 1934-39 children of north-central Utah by more than 0.5 inch in stature, and 7 to 10 pounds in weight.

A third comparative goal was that of placing in juxtaposition the children of the present study and other groups of children as similar as have been reported upon ethnically and secularly, but living in diversified regions of North America far distant from Oregon. Looking to the south, to the east, and to the north, selections most suited to this purpose were made in Texas, Maryland and Virginia, and Minnesota.

For Texas, stature and weight materials gathered 1929-31 (19) and 1937-39 (15) were pooled. The earlier sample was obtained in the public

TABLE 6

COMPARISON OF THE STATURE AND WEIGHT MEANS FROM TABLES 1 & 2 WITH MEANS FOR WHITE CHILDREN STUDIED 1929-39 IN TEXAS (15, 19)

	AGE-SEX GROUP				
	G7	B7	G9	B10	G11
Texas, 1929-39					
Number of subjects	536	491	724	757	695
Mean stature (cm.)	119.9	121.2	130.3	136.1	141.5
Mean weight (kg.)	22.4	23.2	27.2	30.5	33.8
Oregon, 1950-52					
Taller in stature by:	1.5	1.0	2.4	2.7	2.9
Heavier in weight by:	1.3	0.7	2.6	2.4	3.7

schools of San Antonio; it included the run of white children except for a few having "Hebrew, Italian, Greek, Russian, and Syrian" ancestors. The later sample, drawn largely in Bexar, Harris, and Lubbock counties (the counties including San Antonio, Houston, and Lubbock respectively), was part of the previously described survey of American-born white children made by the U.S. Bureau of Home Economics. Composite means from the two studies, together with a listing of the differences between these means and those of Tables 1 and 2, are shown in Table 6. The differences, although statistically significant throughout, are especially marked at ages 9 to 11 years. Stated in terms of the English system of measures, the 1950-52 Oregon children are larger than the 1929-39 Texas children, for stature, by about 0.5 inch at 7 years and more than 1.0 inch after 9 years and, for weight, by around 2 lbs. at 7 years and 5 to 8 lbs. after 9 years.

Stature and weight means on white children residing near the eastern seaboard, and studied as recently as 1937-40, were accessible from investigations made in Maryland (20, 21) and in Maryland, District of Columbia,

and Virginia (15). In the former, the data were from annual school surveys over the period 1937-40 conducted at Hagerstown by the U.S. Public Health Service. The latter comprises material from another portion of the 1937-39 survey (covering 16 States and the District of Columbia) directed by the U.S. Bureau of Home Economics. Reference to Table 7 indicates that the combined means derived from these samples are below corresponding means from the Oregon sample by appreciable amounts. Conversion of the differences to English units gives comparative values indicating that

TABLE 7

COMPARISON OF THE STATURE AND WEIGHT MEANS FROM TABLES 1 & 2 WITH MEANS FOR WHITE CHILDREN STUDIED 1937-40 IN MARYLAND, DISTRICT OF COLUMBIA, AND VIRGINIA (15, 20, 21)

	AGE-SEX GROUP				
	G7	B7	G9	B10	G11
Maryland, et al., 1937-40					
Number of subjects	1225	1189	1515	1618	1519
Mean stature (cm.)	119.2	120.1	129.6	135.3	140.5
Mean weight (kg.)	21.2*	21.9	26.0	29.5	32.6
Oregon, 1950-52					
Taller in stature by:	2.2	2.1	3.1	3.5	3.9
Heavier in weight by:	2.5	2.0	3.8	3.4	4.9

* As in Table 5, but substituting (20, 21) for (2).

the children of Maryland and Virginia are: (*a*) shorter by approximately 0.8 inch at 7 years and 1.5 inches at 10 and 11 years, and (*b*) lighter by roughly 4 to 5 lbs. at 7 years and 7 to 10 lbs. at 10 and 11 years.

The 1937-39 accumulation of data by the U.S. Bureau of Home Economics (15) included a northern sample of white children. This sample was drawn in Minnesota, primarily from the adjacent counties of Hennepin and Ramsey (the counties in which Minneapolis and St. Paul are situated). Table 8 depicts stature and weight means on these 1937-39 Minnesota children and itemizes the extent to which they vary from comparable means on the 1950-52 Oregon children. Explicitly the latter are (*a*) taller by 0.8 inch at 7 years and about 1.0 inch at 10 and 11 years, and (*b*) heavier by 2 to 3 lbs. at 7 years and 4 to 7 lbs. at 10 and 11 years.

Ethnic and secular grounds make it pertinent to reach beyond North America for a further stature and weight comparison. The 1950-52 Oregon sample contains a large representation of children whose ancestors resided in the British Isles. In 1948 a survey was carried out on "about seventeen thousand" English children attending schools "situated in widely scattered

TABLE 8

COMPARISON OF THE STATURE AND WEIGHT MEANS FROM TABLES 1 & 2 WITH MEANS FOR WHITE CHILDREN STUDIED 1937-39 IN MINNESOTA (15)

	AGE-SEX GROUP				
	G7	B7	G9	B10	G11
Minnesota, 1937-39					
Number of subjects	577	561	646	652	642
Mean stature (cm.)	119.1	120.1	130.8	136.4	141.3
Mean weight (kg.)	22.1	22.7	27.6	30.8	34.2
Oregon, 1950-52					
Taller in stature by:	2.3	2.1	1.9	2.4	3.1
Heavier in weight by:	1.6	1.2	2.2	2.1	3.3

parts of England" (17). The published tabular results parallel those of the present study (Tables 1 and 2) in that 10th and 90th percentiles are included. In the case of stature, these percentiles are higher for the school children of west-central Oregon than for the English school children by an average of 3.2 cm. (1.3 inches) at 7 years and an average of 4.2 cm. (1.7 inches) at 10 and 11 years. The differences between the 10th percentiles for stature are of approximately the same magnitude as the differences between the 90th percentiles. That this does not hold for weight is seen from the following: the differences between the 10th percentiles average 0.8 kg. at 7 years and 2.9 kg. at 10 and 11 years, while the differences between the 90th percentiles average 3.5 kg. at 7 years and 6.1 kg. at 10 and 11 years. Composite differences for both percentiles show the children in England to be lighter than the Oregon children by 2.2 kg. (4.9 lbs.) at 7 years and 4.5 kg. (9.9 lbs.) at 10 and 11 years.

In addition to statistics for stature and weight, means for arm girth and leg girth are available on the 1937-39 samples of white children studied by the U.S. Bureau of Home Economics in California; Utah; District of Columbia, Maryland and Virginia; Texas; and Minnesota (15). The anthropometric methods employed in determining both girths approximated those used in the present study except that the measurements were taken on the right extremities.

Examination of the successive columns of Table 9 shows that in every instance the mean for Oregon children is higher than the five comparable 1937-39 means. Considering each row of the table as a whole, the Oregon sample differs most from the sample for north-central Utah and least from that for west-central California. For arm circumference, the Oregon children

are larger than the Utah and California children by overall averages of 1.5 cm. and 0.7 cm., respectively. The three remaining series of arm figures fall below the Oregon series by average amounts approximating 1.3 cm. (0.5 inch) in each case. For leg circumference, the Oregon and California means are almost alike, while the Oregon means exceed the Utah means by an average of 1.3 cm. Other average differences depict calf girth as comparatively greater on the Oregon children by 1.1 cm. (Minnesota), 0.9 cm. (Maryland, et al.), and 0.8 cm. (Texas).

TABLE 9

COMPARISON OF ARM GIRTH AND LEG GIRTH MEANS FROM TABLES 1 & 2 WITH MEANS FOR WHITE CHILDREN STUDIED 1937-39 IN UTAH, TEXAS, MARYLAND AND VICINITY, MINNESOTA, AND CALIFORNIA (15)

	AGE-SEX GROUP				
	G7	B7	G9	B10	G11
Arm girth (cm.)					
Utah*	17.4	17.6	18.5	19.5	19.9
Texas*	17.6	17.7	18.8	19.6	20.3
Maryland, *et al.**	17.8	17.6	18.9	19.5	20.3
Minnesota*	17.6	17.6	19.0	19.4	20.7
California*	18.1	17.8	19.7	20.1	21.5
Oregon†	18.9	18.4	20.5	20.5	22.3
Leg girth (cm.)					
Utah*	23.8	23.7	25.6	26.5	27.4
Minnesota*	23.9	23.7	25.9	26.7	28.1
Maryland, *et al.**	24.3	24.0	26.1	26.7	28.1
Texas*	24.3	24.3	26.0	27.1	28.2
California*	24.7	24.4	26.8	27.6	29.2
Oregon†	24.8	24.7	27.1	27.8	29.4
Number of subjects					
Utah	253	203	349	402	375
Texas	409	382	476	432	492
Maryland, *et al.*	577	466	646	606	647
Minnesota	479	561	558	652	508
California	254	235	266	285	272

* Taken on right limb. † Taken on left limb.

FINDINGS ON BODY FORM

Statistical reduction of the five kinds of data for body shape paralleled reduction of the body size data. Consequently the column sequence of Tables 10 (boys) and 11 (girls) is the same as in Tables 1 and 2.

TABLE 10

CENTRAL TENDENCY AND VARIABILITY VALUES AT 7 AND 10 YEARS OF AGE FOR FIVE MEASURES OF BODY FORM ON A 1950 SAMPLE OF WHITE PUBLIC SCHOOL BOYS IN WEST-CENTRAL OREGON

Ratio	*Mean*	*S.E.M*	*S.D.*	PERCENTILES 5	10	30	70	90	95
SEVEN YEARS: *N* = 260									
Arm girth × 100 / Upper limb length	35.7	.17	2.46	32.0	32.6	34.2	36.8	38.6	40.0
Leg girth × 100 / Lower limb length	45.1	.18	2.85	40.5	41.5	43.6	46.3	48.7	49.7
Chest girth × 100 / Stem length	86.4	.22	3.48	81.0	81.7	84.7	88.0	90.7	91.7
Shoulder width × 100 / Hip width	139.6	.37	5.95	128.9	131.5	136.2	142.9	147.3	149.0
Chest girth × 100 / Abdomen girth	103.8	.23	3.61	97.6	99.0	102.0	105.7	108.3	109.3
TEN YEARS: *N* = 208									
Arm girth × 100 / Upper limb length	34.5	.22	3.13	30.1	31.0	32.7	35.7	37.9	40.8
Leg girth × 100 / Lower limb length	43.0	.21	3.03	38.9	39.6	41.2	44.3	46.5	47.9
Chest girth × 100 / Stem length	87.2	.32	4.54	81.1	82.1	84.9	88.6	93.1	96.1
Shoulder width × 100 / Hip width	140.2	.45	6.45	130.2	132.0	136.9	143.5	147.8	151.7
Chest girth × 100 / Abdomen girth	103.8	.26	3.75	97.0	98.9	102.2	105.8	109.1	110.3

Again, different ends are served by epitomizing the dispersion of each distribution in a single mathematical figure (the standard deviation) and by representing dispersion ordinally with selected percentiles. This follows from having found that the ratio distributions are not all comparable for symmetry and kurtosis. To illustrate: the distributions for predominance of shoulder width over hip width are coarsely symmetrical; the distributions for stockiness of the body stem and extremities register positive skewness.[6]

[6] Tests of skewness made earlier on a sample of boys 15 years of age showed, as here, "the distributions for the upper limb and body stem ratios are skewed significantly to the right" (18, p. 7).

No attempt will be made to discuss Tables 10 and 11 in a comprehensive manner. Rather, findings will be selected with regard to three problems: (*a*) age changes in body form, (*b*) sex differences in body form, and (*c*) description of the body form of individuals.

Age changes in body form. In two previous studies encompassing the childhood years from age 4 to age 8 (11, 13), central tendency graphs for arm girth × 100/upper limb length on age, and leg girth × 100/lower limb length on age, gave "falling curves convex to the abscissa" (11, p. 9). That is, trend lines drawn to ratio means at consecutive annual ages supported "the generalization that during the period from 4 to 8 years of age the extremities of the average boy and girl become less stocky (i.e., more slender) at a gradually diminishing rate" (13, p. 280). The applicable means in Tables 10 and 11 harmonize with, and extend, this generalization. On boys, arm girth is 35.7 per cent of upper limb length at 7 years, and lower at 10 years by 1.2. Corresponding values for leg girth in percentage of lower limb length are 45.1 and 2.1. On girls, the upper limb index declines from 37.3, through 36.6, to 36.2; the lower limb index from 45.8, through 44.4, to 43.4.

In contrast with the ongoing slenderization of the extremities between 4 and 11 years of age, the mean trend for chest girth × 100/stem length is downward during the first half of the period and upward in the last half. The investigations previously cited (11, 13) demonstrated decreasing stem stockiness from 4 to 7 years, while the means in Tables 10 and 11 indicate less stockiness at 7 years than at the older ages. With regard to the rising phase of the curve: (*a*) the boys' means of 86.4 and 87.2 are complemented by a mean of 91.1 on a sample of Oregon boys age 15 years (18, p. 8), and (*b*) the progression in means found for girls is supported by an earlier finding on Iowa girls of a "slightly higher" mean at 8 years than at 7 years (13, p. 278).

A research report on private school children (3) supplies central tendency curves extending from early childhood through adolescence for the index, biacromial width of shoulders × 100/bi-iliocristal width of hips. It is shown that during the elementary school years the index decreases with age in girls and undergoes practically no change in boys. The findings of the present investigation are in general agreement: for boys, shoulder width approximates 140 per cent of hip width at both ages; for girls, the index drops from approximately 140 at 7 years to nearly 137 at 11 years.

The means in Tables 10 and 11 for chest girth × 100/abdomen girth are the same at ages 7 and 9 years on girls, and the same at ages 7 and 10 years on boys. At later ages there are indications that the trends turn in different directions. Specifically, the mean of 100.2 on Oregon girls age 11 is lower than the mean of 101.1 at age 9, and the mean of 105.6 on Oregon boys age 15 (18) is higher than the mean of 103.8 at age 10.

In an investigation at New York City on white boys (16), the pattern of change for chest girth/abdomen girth was studied by graphing means at annual intervals from early childhood through adolescence. This investigation differed methodologically from the Oregon studies in that the numerator used in ratio computation was the midpoint of readings made "at total inspiration and at total expiration" (16, p. 40). A rising index was obtained, the mean at age 10 exceeding that at age 7 by 2.8 per cent and the mean at age 15 exceeding that at age 10 by 2.2 per cent. As noted above, the means for Oregon boys lend no support to increase between 7 and 10 years, but do corroborate an ascending trend in the period 10 to 15 years.

Sex differences in body form. For all of the girth/length ratios in Tables 10 and 11, the average Oregon girl is stockier than the average Oregon boy. On plotting the means at each age, and drawing lines connecting the points for a given sex and ratio, this is found to hold across the age span from 7 years through 10 years. From the previously cited work on Iowa children 4 to 8 years of age, the sex relationships differed somewhat. Consistently, the average girl was the more stocky in upper limb, and the average boy the more stocky in body stem. In lower limb, the average boy was the stockier at ages 4 and 5 years, both sexes were alike at ages 6 and 7 years, and the average girl became "the more stocky by 8 years" (13, p. 280).

Passing to the means for the trunk indices, Tables 10 and 11 show that at 7 years of age the Oregon boys and girls: (*a*) are alike with respect to predominance of shoulder width over hip width, but (*b*) differ in that the predominance of chest girth over abdomen girth is greater for the former by 2.5 per cent. On boys, both ratios at 10 years are approximately the same as at 7 years; on girls, both ratios become lower with age. In other words, for the aspects of trunk form studied, there is no change between 7 and 10 in boys, while girls increase in hip width relative to shoulder width, and in abdomen girth relative to chest girth. The findings on sex relationships for the shoulders/pelvis index reinforce those reported in the aforementioned study of private school children (3).

Girls are more variable than boys in each of the stockiness ratios and in the ratio of chest girth to abdomen girth. More explicitly, for these aspects of body form, the standard deviations on girls are larger than those on boys not only at the age in common for both sexes (7 years) but also without regard to age. That is, the higher standard deviation for the upper limb index on boys (3.13 at 10 years) is less than the lowest on girls (3.43 at 7 years), the higher standard deviation for the lower limb index on boys (3.03) is less than the lowest on girls (3.50), and so forth. For the shoulders/pelvis index, no significant sex difference in variability is found.

Description of the body form of individuals. As a prerequisite to objective description of body form status and progress in individual children,

TABLE 11

CENTRAL TENDENCY AND VARIABILITY VALUES AT 7, 9, AND 11 YEARS OF AGE FOR FIVE MEASURES OF BODY FORM ON A 1951-52 SAMPLE OF WHITE PUBLIC SCHOOL GIRLS IN WEST-CENTRAL OREGON

Ratio	*Mean*	*S.E.M*	*S.D.*	PERCENTILES 5	10	30	70	90	95
SEVEN YEARS: *N* = 168									
Arm girth × 100 / Upper limb length	37.3	.27	3.43	32.3	33.1	35.3	39.0	41.7	42.8
Leg girth × 100 / Lower limb length	45.8	.27	3.50	40.1	40.9	43.9	47.6	50.0	51.5
Chest girth × 100 / Stem length	87.4	.41	5.25	79.8	81.0	84.5	89.3	93.2	98.7
Shoulder width × 100 / Hip width	139.8	.45	5.79	131.2	132.6	136.4	142.7	147.4	149.8
Chest girth × 100 / Abdomen girth	101.2	.38	4.93	91.6	94.7	98.9	103.9	107.5	108.6
NINE YEARS: *N* = 160									
Arm girth × 100 / Upper limb length	36.6	.30	3.78	31.4	32.2	34.2	38.1	41.8	43.5
Leg girth × 100 / Lower limb length	44.4	.28	3.55	39.1	40.1	42.4	46.3	48.8	50.7
Chest girth × 100 / Stem length	87.8	.37	4.71	80.7	82.3	85.3	90.1	94.5	96.5
Shoulder width × 100 / Hip width	139.0	.54	6.78	129.2	131.0	135.1	142.6	148.4	150.3
Chest girth × 100 / Abdomen girth	101.1	.40	5.01	91.9	94.0	98.8	103.8	107.0	108.9
ELEVEN YEARS: *N* = 145									
Arm girth × 100 / Upper limb length	36.2	.31	3.71	30.7	31.6	34.1	38.0	41.2	42.5
Leg girth × 100 / Lower limb length	43.4	.31	3.68	37.5	39.0	41.4	44.9	47.8	50.5
Chest girth × 100 / Stem length	88.3	.48	5.81	80.2	82.1	84.8	90.5	97.1	100.1
Shoulder width × 100 / Hip width	137.4	.56	6.73	126.1	129.4	133.3	141.3	145.7	147.3
Chest girth × 100 / Abdomen girth	100.2	.41	4.93	91.4	93.4	97.8	103.0	105.9	107.6

there is need for the development of metrically-based frames of reference.[7] Beginning work on this task has been included in previous studies on Iowa children 4 to 8 years of age (11, 13) and Oregon boys 15 years of age (18).

Since it is desirable to reduce the number of items in an anthropometric frame of reference to the minimum for adequacy, information on the intercorrelation of items proposed for inclusion is a matter of antecedent concern. To what extent, then, do the five indices of the present study each supply unique knowledge about the body form of the child? Investigation of this question (10, 11, 13, 18) has yielded: (*a*) at ages 4 through 8, 10, and 15 years, coefficients ranging from .29 to .68 for the upper limb index with the stem index, from .26 to .58 for the lower limb index with the stem index, and from .65 to .85 for the lower limb index with the upper limb index; (*b*) at ages 7, 10, and 15 years, coefficients varying between .18 and .37 for the shoulders/pelvis index with the chest/abdomen index; and (*c*) at age 15 years, coefficients that approximate zero for the shoulders/pelvis index with each of the stockiness indices, and are low negative for the chest/abdomen index with each of the stockiness indices. It will be seen that the associations are highest between the upper and lower limb indices; the characterizing figure of $r = .75$, however, is not sufficiently high that an index for one limb of the child can be considered adequate to represent stockiness in both pairs of appendages.

The percentile columns of Tables 10 and 11 serve to section each continuum into seven segments. The segment below the 5th percentile is regarded as constituting one category, that between the 5th and 10th percentiles as constituting a second category, and so forth. It follows that the seven categories afford a practical means of objectively describing individuals with respect to each item of body form included in the tables.[8]

Application of the tables to individual children is illustrated by the following examples. A boy 7 years of age is found to have index values of 31.0 for the upper limb, 42.5 for the lower limb, 86.8 for the body stem, 139.2 for shoulders/pelvis, and 108.9 for chest/abdomen. Reference to Table 10 shows that his profile is 1-3-4-4-6, i.e., described in terms of the "7-year frame" derived from present-day public school boys of west-central Oregon, he has very slender upper limbs, moderately slender lower limbs, average body stem and chest/abdomen configurations, and a marked predominance of width of shoulders over width of hips. Listed in the same order, values for a girl 9 years of age are 42.7, 45.0, 92.3, 128.1, and 101.6. The category equivalents for these values are 6-4-5-1-4, i.e., Table 11 depicts this girl as

[7] In this connection see reference 11, p. 3.

[8] The five ratios of this study must be complemented with additional ratios before a reasonably comprehensive frame of reference on body form will have been constructed. Aspects of form that probably should be added include head width in relation to head length, face width in relation to face height, chest depth in relation to chest width, and stem length in relation to length of the extremities.

having stocky upper limbs, average lower limbs, a moderately stocky body stem, very narrow shoulders relative to pelvis, and an average relationship between circumference of thorax and circumference of abdomen.

Summary

White public school children of west-central Oregon are portrayed with reference to 11 measures of body size and 5 measures of body form. The data were collected 1950-52 on samples drawn to represent boys 7 and 10 years of age, and girls 7, 9, and 11 years of age.

Following description of the subjects and specification of the collection procedures, central tendency and variability analyses are presented on each age-sex group for body weight, stature, stem length, and four dimensions each of the trunk and extremities.

A comparative section on body size places in juxtaposition the Oregon children and other groups of white children chosen to approximate stated ethnic, secular, and geographic permutations. Materials are utilized from west-central California, north-central Utah, Minnesota, Texas, Maryland and Virginia, and England.

The aspects of body form fall into two classes, slender-to-stocky continua (length of stem and limbs in relation to girth) and regional-predominance continua (relations between upper trunk and lower trunk). After presentation of central tendency and variability values for form, these original statistics and statistics from the literature are conjoined in the discussion of three topics: age changes in body form, sex differences in body form, and delineation of the body form of individuals.

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GROWTH AND DEVELOPMENT OF NEGRO INFANTS: IV. MOTOR DEVELOPMENT AND ITS RELATIONSHIP TO CHILD REARING PRACTICES IN TWO GROUPS OF NEGRO INFANTS[1]

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PROBLEM

In an effort to clarify some of the misconceptions about racial differences, a comparative study of a group of white and Negro infants was conducted in New Haven a number of years ago (5). On the basis of performance on the Gesell Developmental Schedules, the average New Haven Negro infant was found to be "fully equal in behavioral development to the average New Haven white baby. . . . No outstanding characteristic was found which could be called a 'racial' difference, with the possible exception of a definite acceleration in gross motor behavior displayed by the Negroes" (5, p. 42). This latter aspect of the New Haven findings, namely, the acceleration of gross motor behavior among Negro infants, is the main concern of the present investigation.

It is postulated that early motor development, accelerated or otherwise, is not a "racial" characteristic but, instead, is related to the manner in which an infant is handled and cared for. As child rearing practices have been shown to vary with socio-economic class (1, 2, 3), the subjects for this study, although all Negroes, were selected from two sharply contrasting socio-economic backgrounds.

[1] The authors wish to express their indebtedness to a number of people for their invaluable contributions to the study: Dr. Benjamin Pasamanick of the Johns Hopkins School of Hygiene not only acted as consultant throughout the conduct of the study but also, together with Dr. Hilde Knobloch, did the independent scoring of the Gesell Schedules; Dr. George Albee is responsible for most of the statistical work; Dr. Melvin Jenkins, Dr. Blanche Bourne, and Dr. Althea Kessler provided subjects from private practice; Dr. Ella Oppenheimer, Director of the Bureau of Maternal and Child Welfare, and Dr. Grace Stone made the facilities of the Maternal and Child Welfare Service available; Dr. Leon Yarrow made many helpful suggestions during the conduct of the study. Dr. Milton J. E. Senn and Dr. Sally A. Provence of the Child Study Center at Yale University read the manuscript and gave helpful suggestions. Dr. F. C. Sumner and Astrea S. Campbell of the Department of Psychology of Howard University also reviewed the manuscript during its preparation for publication. The authors are especially indebted to the Field Foundation, Inc., for financial assistance in this study.

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Specifically, the study was designed to answer the following:

1. Is there a difference in gross motor behavior among Negro infants from an upper and lower socio-economic group?

2. Do the two groups differ in their reported and observed methods of child care?

3. If motor behavior is found to differ significantly for the two groups, can this difference be related to methods of child care?

Method

The subjects for the study were 104 Negro babies, ranging in age from 4 to 18 months, all residents of the Washington, D.C., city area.[4]

Of the 104 babies, 54 (Group I) received their medical care from a private pediatrician. The weekly income of the parents in this group was $80.00 or above.

Of the remaining 50 babies (Group II), 36 were selected from the 150 in attendance at the Freedmen's Hospital Well Baby Clinic. The other 14 were regular patients at one of the District of Columbia Maternal and Child Welfare Service Clinics. The weekly income of the parents of this group was $45.00 or below. The subjects were approximately evenly divided as to sex: there were 26 males and 28 females in Group I; 24 males and 26 females in Group II. (Additional descriptive data about the subjects and their families are given later on.)

All the babies in Group I and the 36 babies from the Freedmen's Well Baby Clinic were first seen at Freedmen's Hospital, in a small but quiet room set aside for the purpose. For Group I, the initial contact was made by the private pediatrician, who briefly explained the project and what it would involve to the mother, and made an appointment. The 36 subjects from Freedman's Hospital were similarly approached by the examiner during regular clinic hours and an appointment was made at the mother's convenience. The 14 babies from the Welfare Service clinic were seen during regular clinic hours at the Health Department Clinic building. The physician in charge explained the procedure, introduced the examiner, and mother and child were then conducted to a room apart from the regular clinic examination rooms. All 14 babies were seen before they went through the routine experience of clinic itself.

In all cases the first session was begun with a short preliminary interview conducted with the adult who brought the baby, in most cases the mother, occasionally both parents. A few of the working mothers who could not arrange to come themselves sent the baby with the regular mother-substitute. The interview followed, in general, the one outlined by Gesell and Amatruda in *Developmental Diagnosis* (4, p. 91) and covered the baby's motor and language development, play, domestic and emotional

[4] Washington city excludes bordering areas of Maryland and Virginia.

behavior. An attempt was made to keep the interview less directive than suggested by Gesell.

In addition, information was secured as to the economic background of the family, the age, education, occupation and geographic origin of the parents, the housing of the family, the number and age of the subject's siblings. The examination itself was then conducted. It was limited to the gross motor items on the Gesell Developmental Schedules. The few materials necessary for the administration of these items were available both at Freedmen's Hospital as well as at the Health Department Clinic—the crib, small chair, the balls, and the introductory toy, usually given to the baby while the interview was in progress and used again, if necessary, to induce such items as pivoting, cruising, etc. The performance was recorded on the regular schedule form during or immediately after the examination. Observational notes on the baby's behavior and on the interaction between adult and child were also made, but, because of time limitations, were in most instances rather brief.

Of the 104 babies, 91 were seen again from three to six months after the initial contact. At this time the babies were visited in their homes.[5] The visit lasted for approximately one hour and was devoted to observation of the subject in interaction with the mother or mother-substitute and a detailed interview which covered the following areas: prenatal care and health of the mother; postnatal condition, care, and health of mother and child; feeding and weaning of the child and the mother's attitudes toward these; toilet training; sleeping habits and discipline. There were a number of questions included which related to general attitudes ("Is the baby a lot of trouble?" "What do you do if the baby cries?" etc.). The body of the interview was devoted to various aspects of dealing with and handling the baby which were felt to have a direct bearing on motor development: the amount of restriction and/or freedom of movement the baby has; means by which he is restrained; the extent and kind of contact he is permitted with other persons or objects; the amount and kind of encouragement given to the various motor functions; kinds of games played with the baby and amount of time spent in play; ways in which the baby is moved and carried. An effort was made to interview the person who most consistently cared for the child. In a few instances the mother insisted on being seen even though her contact with the child was minimal. The mother was interviewed whenever a number of people shared in the care of the child and when no one person was consistently responsible. Whenever two people

[5] Fifty-one of the babies in Group I were seen a second time. Of the three in this group who were not seen again, one had moved out of town and the other two could not be reached by phone, mail, or direct visit and did not return to their pediatrician. Of the 10 babies in Group II who could not be contacted, one was given up for adoption out of town, one was boarded with an aunt who consistently refused to see the examiner, three are definitely known to have moved, and the remaining five could not be located at their last address and never returned to clinic.

TABLE 1

YEARS OF EDUCATION OF PARENTS IN GROUPS I AND II

No. of Years	Group I		Group II	
	Mothers $N=54$	*Fathers* $N=54$	*Mothers* $N=50$	*Fathers* $N=50$
19 or more	—	6	—	—
17 — 18	5	5	—	—
15 — 16	16	9	—	1
13 — 14	13	12	2	—
11 — 12	19	17	23	21
9 — 10	1	3	11	7
7 — 8	—	2	9	5
5 — 6	—	—	3	2
3 — 4	—	—	2	—
Unknown	—	—	—	14

participated equally, an attempt was made to elicit whatever conflict existed in respect to the care and attitudes toward the baby. The interview was, as much as possible, kept loosely structured. Topics of discussion were suggested in the broadest terms and the interviewee was encouraged to talk freely and at length. However, there were some cases in which a great deal of prodding was necessary to secure information and in which questions had to be phrased with increasing directness. A rating of the home, including an evaluation of the neighborhood, the condition of the dwelling unit itself, and the adequacy of space and furnishings, was also made at the time of the visit.

The subjects. Before the results of the study are presented, it is necessary to give further descriptive data about the subjects and their families. As the study is primarily a comparative investigation of motor development among Negro infants of contrasting socio-economic backgrounds, it is important to establish that these backgrounds are truly different and stand in contrast to each other. The initial selection of subjects was made on the basis of family income and the kind of medical care the baby was receiving—namely, that of a private pediatrician or a free clinic. Income is a fairly objective criterion of economic level; the kind of medical care a family has is not only a reflection of the former but also a clue as to the family's "self-concept of status."[6] The data presented below show that, in addition

[6] The pediatricians from whose practice the subjects in Group I were drawn are all on the staff of a university hospital as well as a medical school and have a great deal of professional status and prestige.

to these two factors, sharp differences exist between the two groups as to housing and the parents' educational and occupational levels.

According to the preliminary 1950 census figures for Washington city (8), 21 per cent of the Negro population in the area has an income of $4,000 or above. Of the 54 subjects in Group I, 13 are in the $4,000 to $4,500 range. The rest are in the above $5,000 income bracket, or the uppermost 13 per cent of the Negro population in Washington city. With the exception of six families who make approximately $2,300 a year, the families in Group II fall below the $2,000 a year income limit, or within the lowest 31 per cent of the Negro population of Washington city.

Table I gives the educational level of the parents in the two groups. While most of the parents in Group I have an educational level of high school or above, those in Group II have one of high school or below. The mean educational level is 13.9 years and 14.0 years for the mothers and fathers of Group I respectively; the mothers of Group II have a mean of 9.8 years of education while the 36 fathers of that group whose educational background is known have a mean of 10.5 years.

TABLE 2

OCCUPATIONS OF PARENTS IN GROUPS I AND II

	Group I		Group II	
	Mothers $N=54$	*Fathers* $N=54$	*Mothers* $N=50$	*Fathers* $N=50$
Professional*	17	11	—	—
Professional Athlete	—	1	—	—
Business†	—	7	—	—
Clerical	31	24	5	4
Sales	3	—	1	—
Skilled Trades	—	11	—	2
Unskilled Labor	—	—	6	28
Domestic Work	—	—	27	2
Unemployed‡	—	—	—	2
None§	3	—	11	—
Student	—	—	—	1
Armed Forces	—	—	—	6
Unknown	—	—	—	5

* Includes 8 nurses.

† Includes 3 who own taxicabs.

‡ When employed, worked as unskilled laborer.

§ Never worked.

TABLE 3

BIRTHPLACE AND YEARS OF RESIDENCE IN WASHINGTON, D.C., OF PARENTS IN GROUPS I AND II

	Group I		Group II	
	Mothers $N=54$	*Fathers* $N=54$	*Mothers* $N=50$	*Fathers* $N=50$
Born in D.C.	20	18	15	14
Born in South	24	33	33	33
Born Elsewhere	10	3	2	2
Birthplace Unknown	—	—	—	1
D.C. since 1940 or Earlier	28	27	22	25

As shown in Table 2, there is only a slight overlap in terms of occupations for the parents in the two groups. While the bulk of mothers and fathers in Group I hold professional or clerical positions, none of the parents in Group II are in the former category and only five mothers and four fathers are in the latter. There may also be some differences as to the level of clerical work for the two groups, although this information was not obtained. Most of the mothers in Group II are or were in domestic work, while most of the fathers are unskilled laborers.

Table 3 deals with the information relating to the parents' place of birth and length of residence in Washington, D.C.

Table 4 summarizes the housing conditions for the two groups. Only the 91 homes which were visited by the examiner are included in the table. Each home was rated on a three point scale (excellent, adequate, inferior), and such factors as neighborhood, conditions of the dwelling unit, adequacy of space, were taken into account when the rating was made. In the excellent category are not only private homes but also the better of the housing projects, apartments of adequate size with all necessary facilities such as

TABLE 4

HOUSING CONDITIONS OF SUBJECTS IN GROUPS I AND II

Rating	*Group I*	*Group II*
Excellent	43	4
Adequate	8	22
Inferior	—	14

heat, light, and plumbing. Most of the inferior homes were slum dwellings, usually one room units in dilapidated areas and buildings. The houses rated as adequate fall in the hard to define and describe in-between range, usually comprise apartments in old buildings, shared and somewhat crowded homes, or older and slightly deteriorated projects. The housing conditions for Group I are most often excellent, while the bulk of Group II live in homes rated adequate or inferior.

As part of the socio-economic evaluation of the families, it should be mentioned that none of the 54 babies in Group I are illegitimate and that none of the parents in that Group were either separated or divorced at the time the babies were seen. Six of the 50 babies in Group II are definitely known to be illegitimate. In four additional cases the parents were not living together at the time the babies were seen and the mothers were evasive when questioned about their exact marital status. The clinic record for two of these four describes their status as illegitimate; for the two other cases no additional information could be found in the record.

The following data pertains to the infants themselves. Table 5 gives the age distributions for the two groups. The mean age for Group I is 41 weeks, for Group II 38 weeks. These ages refer to the time of the first examination.

TABLE 5

AGE DISTRIBUTIONS FOR GROUPS I AND II

Age	*Group I* $N=54$	*Group II* $N=50$
18 months	2	3
16 — 17 months	6	1
14 — 15 months	6	3
51 — 56 weeks	3	3
45 — 50 weeks	7	6
39 — 44 weeks	4	6
33 — 38 weeks	5	8
27 — 32 weeks	6	9
21 — 26 weeks	8	4
— 20 weeks	7	7

Insufficient growth data is available to report and compare growth progress and patterns for the two groups. However, a comparison of birth weights, available for all infants, show considerable difference for the two groups, the mean for Group I being 7.46 pounds (3387 grams) and for Group II, 7.0 pounds (3178 grams). The birth weight range for Group I

was 5 pounds 14 ounces to 9 pounds 9 ounces; for Group II the range was 5 pounds 3½ ounces to 9 pounds 1 ounce.[7]

No record of degree of pigmentation was kept for the subjects. Babies in both groups ranged from dark brown to very light, with those in Group I somewhat lighter, on the whole, than those in Group II.

There is no essential difference as to the number of siblings in the two groups. Thirty-nine of the 54 babies in Group I are only children, 9 have one older sibling, 3 have two older siblings, one has three older siblings, and 2 have one younger sibling. In Group II, 35 of the 50 babies are only children, 7 have one older sibling, 7 have two older siblings, and one has three older siblings.

The health records for the two groups were examined and additional information on health histories was secured from the mothers and, if necessary, from the physicians. Only full-term, healthy babies were included in the study. For Group I, the following illnesses were reported prior to the time the babies were first seen: 7 cases of diarrhea; 1 case each of measles, chicken-pox, colic; 1 naval hernia; 1 case of pyloric stenosis for which an operation was performed at the age of two weeks. This infant was hospitalized for four or five days and when seen for his developmental examination, was 21 weeks old. In Group II there were 8 cases of diarrhea; 1 hernia which required a week's hospitalization at the age of one year (the child was seen when 18 months old); 2 cases of slight eczema; 1 virus infection with temperature. Common colds were reported for almost all the children in the two groups.

At this point it might be pertinent to describe the rather striking difference in reactions on the part of the parents in the two groups to the entire examination procedure and situation. As already mentioned, the subjects in Group I were contacted by their private physicians. Hardly any of the appointments made were broken. The mothers were eager to have the examination performed and most came with many questions about their child's "intelligence," showed great concern about "retardation," and needed much reassurance about their baby's development. Comments such as "Shouldn't he be walking?", "Does she do as well as other children?", "Do you really think he is all right?" were extremely common. There was embarrassment if the mother thought the child was not "performing" and much pressure was exerted to get him to show his various "tricks."

Among the 36 Freedmen's Hospital Well Baby Clinic subjects, the problem of motivating the mothers to come was a major one. Once the mothers brought their babies for the examination, there was interest, but none of the anxious concern that was so characteristic of Group I mothers. Favorable comments about the baby's development were, of course, accepted with pleasure but also greeted with such remarks as: "Yes, we know she is smart," "Sure he does well," "All my children are quick." Demands for

[7] For additional data on birth weights among Negroes, see Scott *et al.* (7).

reassurance were rare. The most prevailing reaction in this group of mothers was acceptance of and confidence in the baby and pride in his development. There was little manifestation of pressure on the child, which seemed so pervasive among the parents of Group I.

Results

The developmental examinations. The gross motor items on the Gesell Developmental Schedules had been administered to each subject. An estimate of the level of maturity in the gross motor area was made and from this evaluation a Developmental Quotient was computed:

$$\text{D.Q.} = \frac{\text{Maturity Age}}{\text{Chronological Age}} \times 100.$$

The 104 Gesell record forms, without identifying data except name and age, were submitted to two experienced examiners for independent evaluations and scoring. The reliability of the original D.Q.s with those of the first independent examiner was .98, and with those of the second, .99. Both of these coefficients were, of course, significant at the .01 level of confidence. The following data are based on the original scores.

Table 6 lists the mean D.Q.s for Group I (upper socio-economic level) and Group II (lower socio-economic level). The "*t*" value is significant at about the .02 level of confidence and indicates significantly higher motor development for the babies from the lower socio-economic group.

TABLE 6

GROSS MOTOR D.Q.'s FOR GROUPS I AND II

	Mean D.Q.	*Standard Deviation*	*t**
Group I ($N=54$)	107.57	15.10	2.33
Group II ($N=50$)	114.32	14.14	

* For 100 degrees of freedom, *t* must be 2.62 for the .01 level of confidence and 1.98 for the .05 level of confidence.

Each of the two groups was then divided into (*a*) those 37 weeks of age or younger, and (*b*) those 38 weeks or older, in order to ascertain whether the superior motor development of Group II achieved its significance early or late, or whether these infants were ahead consistently, and, finally, whether motor development, regardless of group, shows any consistent trend with age.

Table 7 shows the means of the younger and older subjects of both groups. It will be noted that the babies in the lower socio-economic group appear to be more advanced at both stages of development, although, because of the greater variability of the sample at the younger age level, only the older infants differ significantly in the present comparison. As shown by the increasing means for both groups, motor development seems to accelerate with age.

TABLE 7

MOTOR D.Q.'s FOR GROUPS I AND II FOR TWO AGE LEVELS

	Group I		Group II		
	Mean	*S.D.*	*Mean*	*S.D.*	*t**
Younger	103.92	15.00	110.74	16.55	1.54
Older	111.00	14.04	118.52	9.16	2.26

* A *t* value of 2.00 is required for significance at the .05 level of confidence.

To sum up this portion of the results, the infants of Group II show significant acceleration of gross motor behavior when compared to those of Group I. These differences appear to hold in both younger and older groups of infants, although the variability in the younger group obscures this difference.

The interview. Fifteen separate categories expressing different child care practices were devised to make the previously described interview material more objective. All but one of these categories were expressed as dichotomies. The 15 categories are cited below. The first few deal with general child care practices which in other studies (1, 2, 3) were found to have a relationship to socio-economic class.

1. Duration of breast-feeding (four groupings): not at all, 3 months or less, 4 to 5 months, 6 months or longer.
2. Feeding schedule: rigid—flexible.
3. Inception of bottle-weaning: before 12 months—after 12 months.[8]
4. Food forced against will: yes—no.
5. Inception of toilet training: before 12 months—after 12 months.[8]
6. Sleep routine: rigid—flexible.
7. Discipline: necessary—restrictive.

[8] Bottle-weaning and toilet-training could not be dealt with in greater detail because of the wide age range of the subjects; in some instances neither weaning nor training had begun and the expected age for their inception had to be probed for.

8. Attitudes on non-approved habits: permissive—punitive.

The remaining seven categories are those dealing with practices felt to have a direct bearing on motor behavior and each requires a word of explanation.

9. Area restriction: yes—no. The concern here was primarily with the extent to which the child is kept in one place and out of others, the amount of freedom he has in moving about the home.

10. Mechanical restriction: necessary—restrictive. This category indicates whether devices such as crib, playpen, baby-tender, or whatever is appropriate at a given age are used with limits and for their intended purpose or whether they serve and are extensively used to insulate the child from his environment.

11. Freedom to experiment: extensive—limited. This category embraces all the interview answers which gave clues to the amount of freedom the child has to exercise his motor functions and experiment with motion.

12. Reaching out: permitted—intimidated. The concern here is with how the child's outgoing motions toward objects and persons are dealt with, whether active interplay is encouraged or discouraged.

TABLE 8

CHILD REARING PRACTICES AND THEIR RELATIONSHIP TO SOCIO-ECONOMIC GROUP

*Rearing Practice**	*Group I* $N=51$ +	—†	*Group II* $N=40$ +	—	*Significance Level*
Feeding Schedule (Rigid +, Flexible —)	37	14	19	21	.03
Bottle Weaning (Before 12 mos. +, After —)	14	37	7	33	—‡
Food Forced (Yes +, No —)	8	43	3	37	—
Toilet Training (Before 12 mos. +, After —)	34	17	23	17	—
Sleep Routine (Rigid +, Flexible —)	45	6	21	19	.01
Discipline (Restrictive +, Necessary —)	25	26	9	31	.019
Habits (Punitive +, Permissive —)	26	25	13	27	—
Area Restriction (Yes +, No —)	13	38	11	29	—
Mechanical Restriction (Restrictive +, Necessary —)	48	3	16	24	.01
Freedom to Experiment (Limited +, Extensive —)	26	25	15	25	—
Reaching Out (Intimidated +, Permitted —)	37	14	18	22	.016
Bodily Contact with Others (Limited +, Extensive —)	34	17	22	18	—
Time with Others (Limited +, Extensive —)	23	28	12	28	—
Motor Development (Encouraged +, At own rate —)	39	12	34	6	—

* The data on breast-feeding are given in a separate table.

† + indicates the more rigid pattern, — the flexible or permissive one.

‡ Significance level greater than .05.

13. Bodily contact with others: extensive—limited. Dealt with here are all answers which indicate the degree of active body contact the child has with others—how much is he held, carried, actively played with.

14. Time with others: extensive—limited. The concern here is simply with the amount of time the child is alone or in the company of other children and/or adults.

15. Motor development: encouraged—left to develop at own rate. This last category deals with the degree to which motor functions such as sitting, creeping, standing, walking, were anticipated and encouraged by the family, or left to develop at the child's own rate, without any pushing.

The reliability of judgment for placing subjects in these categories was in no instance lower than 90 per cent agreement for the examiner and one independent rater of the interview material.

The relationship of each of these child care practices to socio-economic background was determined by separate chi-square tables in which frequencies of each kind of child rearing practice were tallied for the two groups and compared for deviation from chance expectancy. Table 8 summarizes the results of these tests.

The comparison between breast-feeding and socio-economic group is given in Table 9. The chi-square for this table is 10.02 and is significant at the .02 level of confidence.

TABLE 9

DURATION OF BREAST-FEEDING COMPARED FOR GROUPS I AND II

	Not at All	*Up to 3 Mos.*	*4—5 Mos.*	*6 Mos. or More*
Group I ($N=51$)	19	28	3	1
Group II ($N=40$) ...	8	18	8	6

Of the 15 categories, the following show a significant relationship to socio-economic background: breast feeding is more prevalent and longer among Group II; feeding schedule and sleep routine are more rigidly enforced among members of Group I; discipline tends to be more restrictive among members of Group I; means of mechanical restriction are more often used to insulate the babies of Group I than of Group II from direct contact and interaction with their environment; reaching out motions of the child are more often discouraged in Group I. Of the remaining 9 categories which are not statistically significant, there is a tendency toward greater permissiveness on bottle-weaning, toilet-training, non-approved habits, and freedom to experiment in Group II. A greater proportion of children in that group also spend more time with others and have closer

bodily contact with others, although again these differences are not statistically significant.

The results to this point indicate that (*a*) motor development is significantly higher among babies of the lower socio-economic group and that (*b*) certain child rearing practices are associated with socio-economic level. In order to establish whether a relationship exists between motor development and child rearing practice, the two groups of subjects were combined and bi-serial correlations computed between each child rearing practice (the dichotomy) and developmental quotients (the continuous variable). None of the correlations are above .40. Three were significant at the .05 level, one at the .01 level. The 4 of the 15 practices which have a significant relationship to motor development are:

1. Attitudes on non-approved habits (.05). Children from homes that are permissive rather than punitive about generally non-approved habits do better than children who are punished for non-approved habits (thumb-sucking, hair-pulling, etc, etc.).

2. Area restriction (.05). Children who are not restricted as to area, who can freely move about the home, have a higher motor D.Q. than children who are restricted and kept in one place.

3. Reaching out (.05). Children whose outgoing motions toward objects and persons are encouraged, who enjoy free and active interplay with their environment do better than those from homes where active interplay and reaching out is discouraged and punished.

4. Motor development (.01). Children who are left to develop at their own rate in the motor area do so more quickly than those whose motor functions such as sitting, standing, walking, etc., are anticipated by the family, who are "pushed" as far as their motor development is concerned.

Although none of the remaining catgories are statistically significant when correlated with motor development score, all show a trend in the same direction: permissiveness, flexibility, lack of restriction, enhance motor development as measured by the Gesell Developmental Schedules.

Global rating. The observations made on the 91 subjects whose homes were visited were rated by the examiner and again by an independent judge who had no knowledge of the subject's test performance.[9] These observations consisted of detailed notes on interaction between subject and adult as they appeared both at the time of the first contact at the hospital and again during the hour long home visit. The judges characterized each family as either permissive-accepting or rigid-rejecting. Eighty-six of the 91 interviews resulted in agreement. The remaining five homes were then discussed together and assigned to one or the other category.

[9] The examiner did the ratings several months after the developmental examinations had taken place and when, in almost all of the cases, there was no recall of the subject's test performance.

TABLE 10

THE RELATIONSHIP OF GROSS MOTOR DEVELOPMENT SCORES AND HOME ATMOSPHERE RATINGS

	N	*Mean D.Q.*	*S.D.*	*P*
Total Group				
Permissive	65	114.03	14.99	.01
Rigid	26	100.73	11.29	
Group I				
Permissive	30	113.37	16.03	.01
Rigid	21	100.52	10.56	
Group II				
Permissive	35	114.60	14.26	.05
Rigid	5	101.60	15.40	

Of the 65 homes rated as permissive, 30 were from Group I, 35 from Group II. Of the 26 rated rigid, 21 were from Group I, 5 from Group II. Table 10 illustrates the significance of these ratings to motor development.

It is evident from Table 10 that the important determiner in motor development is the home atmosphere rather than the socio-economic status of the family. When the mean D.Q.s of the children of permissive families in Groups I and II are compared, no differences are apparent; neither do the D.Q.s differ for children from the homes rated as rigid in Groups I and II. When, however, separate comparisons are made within these groups, the children from permissive families show significant acceleration for Group I; for Group II the difference only approaches significance, probably because of the small number of rigid homes in that group.

DISCUSSION

Gross motor acceleration has often been one of the stereotypes attributed to the Negro child and the implication has been made in the literature as well as in the folklore that motor functioning among Negroes is advanced while the rest of mental development lags behind. The present investigation suggests that acceleration of gross motor development is not a "racial" characteristic but is, to an extent, related to the way in which a child is cared for and handled, in turn a function of socio-economic level.

The motor score D.Q.s of the subjects of the upper economic income group in this study approximated that previously established for white groups (5). The infants from the lower socio-economic group showed, on the average, gross motor acceleration.

The statistical difference between the motor score means of the two groups was small (at the .05 level) and a number of factors which may have reduced this difference are cited here.

1. The subjects of Group II were somewhat younger than those in Group I. In the present study as well as in previous ones (5, 6), motor development has been found to accelerate with age. Had the groups been equally matched for age at the time of examination, the difference in motor development might have been greater.

2. The previously cited New Haven study found that infants heavier at birth were favored in most fields of development (5). The mean birth weight of Group II infants was almost a full half-pound below that of Group I.

3. The possible retarding effect of certain environmental factors such as poor housing, for instance, can only be speculated upon as these were not specifically investigated here. However, some mention ought to be made of diet and its effect upon development. The lower birth weight of Group II infants is probably a reflection on the mother's less adaquate pre-natal diet and care.[10] No information was obtained on post-natal diet differences for the two groups. It is fairly safe to assume, however, that in a period of high food and other living costs, the family whose income is over $4,000 a year is better fed than the one whose income is below $2,000.

In view of the above, the difference in motor development score for the two groups might well have been greater if the subjects could have been equally matched for age and weight and if their diet could have been controlled in some way.

The differences in rearing practices established for the two groups closely correspond to previous findings. Davis and Havighurst (2), in a study of rearing practices in each of four groups (white middle, white lower, Negro middle, Negro lower class), found considerable class differences[11] which were greater than differences between Negroes and whites of the same social class. Middle class families were found to be more rigid in training for feeding and cleanliness habits, were less permissive in regimen. Ericson's (3) findings closely correspond to those of Davis and Havighurst. She further mentions the greater emphasis on achievement among the middle class, which is also more exacting in its expectations. This difference

[10] The average time for starting medical care during pregnancy for mothers in Group I was the second month; for mothers in Group II, the seventh month.

[11] Group I closely corresponds to Davis' and Havighurst's "middle-class," Group II to the "lower class."

was very apparent in the previously described reactions on the part of the adults in the two groups to the initial testing situation. Manifestations of pressure on the child, concern about performance and achievement, anxiety about possible retardation, were prevalent among mothers of Group I and almost entirely absent among those of Group II. Ratings as to permissiveness-acceptance and rigidity-rejection made on the basis of observations bear out even more pointedly this difference between the groups. Only 5 of the 40 low-income group homes were rated as rigid, while 21 of the 51 homes in the high income group fitted into that category.

The differences in care and handling which were noted might have been even more pronounced if all the subjects in both groups had been cared for by their mothers. A variable which was not at all controlled in the present study was the large number of working mothers in Group I.[12] In many instances in which the mother worked full-time, the child was cared for by a neighbor, relative, or paid domestic, who, if largely responsible for the child, also acted as informant in the interview. It is very likely that these mother-substitutes handled and cared for the children in a way that conformed much more closely than the mother's own to the standards of the low socio-economic group from which many came.

One other factor may have obscured the differences in rearing practices between the two groups. An implied assumption of the study was that Negroes from the upper socio-economic strata are closely identified with white middle class standards and also pattern their child rearing practices in conformity with those of the white middle class. Had the study been done some years ago, before "permissiveness" became one of the keynotes of contemporary child rearing philosophies, the difference between the two groups might have been sharper and more striking.

Just as Group II families were less rigid than those from Group I as to feeding, regimen, discipline, etc., they dealt less restrictively with the child's motor activities. The two practices in this area which show a statistically significant relationship to socio-economic group are "mechanical restriction" and "reaching out." Children in Group I are much more often insulated from their environment by cribs, tenders, high chairs, etc. These are not only used to sleep or feed the baby, as was their original purpose, but utilized, for a large part of the day, to set up a barrier between the baby and the people and objects around him. Group I babies have little active interplay with their environment and little opportunity for making outgoing, experimental motions. Taken as a whole and regardless of statistical differences, the picture for the subjects from the low socio-economic group is a much more active, free and uninhibited one; they have a closer, much more direct and manipulating relationship to their environment than the babies in the high socio-economic group.

[12] Thirty-three of the original 54 mothers in Group I were employed, while only 10 of the 50 mothers in Group II were employed.

One of the major shortcomings of this study is that the information pertaining to motor activity and ways it is dealt with had to be gathered by means of an interview and an hour long observation period. The only adequate and satisfactory way of obtaining such information is through intimate knowledge of the child and prolonged, consistent observation of the child in interaction with those who care for him. While information on bottle-weaning or training can be elicited in fairly clearcut fashion by means of an interview, such concepts as insulation from the environment or freedom to experiment are hard to define, harder to elicit in an interview, and hardest of all to deal with in a purely quantitative manner.

There is an apparent contradiction on the findings between the relatively low level of significance when D.Q. scores and specific child care practices are correlated, and the highly significant relationship between motor development score and rating of home atmosphere as to permissive-accepting and rigid-rejecting. It will be recalled that these latter ratings were made on the basis of impressions of and observation on the interaction between adult and child during the first contact at the hospital and again during the home visit. These observations dealt not with the specific practices as did the interview, but with what can best, but only nebulously, be described as the "atmosphere" within which the child grows up, the "tone," the "feeling" of the home. Here again it is unfortunate that this descriptive, "qualitative" material had to be reduced to a rating. The most highly significant relationship, however, was found between these ratings and the motor development score, with infants from homes rated as permissive-accepting doing better on the Gesell Schedules than infants from homes rated as rigid-rejecting (the respective means for the two groups were 114 and 100). None of the correlations between score and specific practice, on the other hand, were above .40 and only 4 of the 15 practices show a significant relationship to score (although all are in the expected direction). One possible explanation suggests itself for this apparent inconsistency. It may be that the violation or observance of a specific practice is less decisive to motor development than the overall atmosphere within which a child is reared. In other words, and hypothetically, the feeding and training procedure for a given infant may be exacting, but if his overall relationships are accepting and warm, his motor development, as measured by the Gesell Schedules, will be enhanced.

A number of limitations should be mentioned which make all of the above suggestive rather than conclusive. One of these limitations is that only one examination was conducted with each child. The data might have been more conclusive if all of the subjects could have been re-examined at periodic intervals. This would, among other things, have provided some check of the child's state at the time of examination. It is quite possible, for instance, that the tension and eagerness to have the child perform which was so very much in evidence among the mothers in Group I had a negative

effect on the subjects' performance. Furthermore, it was unfortunate that only the motor items rather than the entire Gesell scale were administered. Although the observations and initial interview supplemented the information obtained from the developmental examination and served to establish that the subjects were all within the range of normal development, it would have been preferable had this information been substantiated by Gesell material.

The results would have been considerably more meaningful if the age range of the subjects were less wide. The material would have been more conclusive had comparisons been made of children of the same age.

Another shortcoming is inherent in the Gesell scale itself. Toward the end of the first year, there are very few gross motor items and the difference from one key age to the next is often difficult to evaluate.

Finally it should be mentioned that a false inference which might be made from the above discussion is that if only given the proper stimulation and setting, an infant's motor development will flourish. Throughout this presentation the assumption has always been that a child's motor development may be accelerated or retarded by differential handling and home atmosphere but that this will only take place within the limits set by his endowment, be it high or low.

Summary

The gross motor development of two groups of Negro infants from sharply contrasting socio-economic backgrounds was investigated in an attempt to determine whether gross motor acceleration is a "racial" characteristic or related to the manner in which an infant is handled and cared for. The infants from the low socio-economic group showed significant gross motor acceleration when compared to those from the high socio-economic group. Significant differences were also found for the ways in which the infants of the two groups were handled. Specific practices as well as the overall home atmosphere were more permissive and less exacting among families of the low socio-economic group. Differences in motor development were found to be related to methods of child care, with infants from permissive, accepting environments scoring significantly higher on the Gesell Developmental Schedules than infants from rigid, rejecting environments. The findings suggest that motor acceleration is not a "racial" characteristic.

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THE EFFECTS OF A MOTOR HANDICAP ON PERSONALITY: I. THE EFFECTS ON LEVEL OF ASPIRATION[1]

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Any comprehensive theory of personality must recognize the important role which the motor apparatus plays in a child's development. To mention just a few examples: it enables him to explore his environment and to develop techniques for independent mastery of problem situations; in his defense repertoire it is activated during the flight which accompanies fear, the destructiveness which accompanies anger, as well as the inhibitions which accompany the formation of conscience; it allows for the expression of free energy in play and other creative activities.

It follows, then, that a motor apparatus which is not intact should present problems which affect the child's entire personality structure. The following studies were designed to explore the effect of motor handicap on certain aspects of the child's personality.

STATEMENT OF THE PROBLEM

There are many reasons for hypothesizing that a child with a motor handicap will face special problems in setting realistic goals for himself. To begin with, his ability to perform efficiently is often seriously disrupted, leaving him with a confusing inconsistency in regard to how he will perform in the future. His parents have to deal not only with unsettling emotional attitudes which may be aroused in such a child, but also with a far less clearly defined standard of growth by which to gauge his development. Thus, the child is more likely to be pushed by a parent who believes he is especially gifted or overprotected by one who believes he is relatively helpless. Finally, there are many areas in which the behavior of his non-handicapped peers cannot be used to set the standard of expected achievement.

The present study was designed to test the hypothesis that the goals which a handicapped child sets for himself differ significantly from those of a non-handicapped child. Neither theoretical nor clinical observation is refined enough, however, to enable one to predict specifically what the

[1] These studies were sponsored by The Coordinated Program for Handicapped Children, and were done at The Institute for Psychosomatic and Psychiatric Research and Training, Michael Reese Hospital, Chicago, Ill.

difference will be: e.g., whether he will set unrealistically high goals in order to compensate for his handicap, unrealistically low goals in order to protect himself from failure, or whether he will adopt some other pattern of goal setting which differs from that of the non-handicapped child.

METHOD

Subjects. The subjects were 12 children with no motor handicap, 12 with a mild motor handicap, and 12 with a severe motor handicap. All were pupils in the Chicago public school system, between the ages of 8 and 10, of average or above intelligence, with no other severe physical handicap. The age range was chosen as representing a particularly stable period in the child's development, since the transition from a life centering around the home to one centering around both school and home has usually been made, and the difficulties of early adolescence have not yet started. The reason for equating the groups for intelligence and limiting the experimental groups to a single handicap was to see the effects of the motor handicap uncomplicated by such factors as mental retardation and other types of physical defects, both of which could have a significant effect on personality.

In all cases the handicapped children were suffering from different kinds of cerebral palsy and the motor handicap had been present from birth. Two criteria were used to determine degree of handicap: first, a rating by the examiner based on observing the child's gross motor coordination in class and on the way to the testing room, and observing his finer motor coordination in handling the test material; second, an objective criterion in terms of the number of pegs the child could place in a pegboard in a 20-second interval. It should also be noted that there were two criteria for the moderately handicapped group: a moderate or mild case of spasticity or athetosis affecting all limbs, or a severe spasticity which affected only two limbs, leaving the other two relatively intact. The only practical limitation for the severely handicapped group was that the child could not be so crippled as to be unable to handle the material used for testing.[2]

It is important to emphasize that the control group was made up of non-handicapped children, and no attempt was made to get normal, well adjusted individuals. Since the handicapped children were selected with

[2] The handicapped groups consisted of 12 spastic and 12 athetoid children, and all the data were analysed according to type of handicap as well as severity. When this was done there was either no significant difference between the groups, or the differences were so unsystematic that they had little psychological meaning. However, one cannot conclude from this that the type of handicap does not significantly affect the personality variables tested because it was impossible to equate the groups for severity—the spastics contained a predominance of moderately handicapped children while the athetoids contained a predominance of severely handicapped children. Thus, with this sample, the findings are indeterminate when examined in terms of kind of handicap.

a complete disregard to the type of adjustment they were making, it would be erroneous to compare them with a special segment of the non-handicapped children whose adjustment was outstandingly good.

Procedure. The experiment consisted of a slightly modified form of the level of aspiration technique. The subject was seated at a table upon which there were two pegboards, each 36 × 5 × 1 inches. Each board contained 20 square holes ⅜ inch in diameter. The board the subject was to use had a square peg 4 inches long and ⅜ inch in diameter in front of each hole. Instructions were as follows: "This is a game to see how many of these pegs you can put in the holes before I say *Stop*. You see, they go in like this (illustrates with three pegs). Now you try a few. (Subject places three.) Fine. Now, when I say *Go*, you start and put in as many as you can till I call *Stop*."

For this and each of the subsequent trials, the subject was given 20 seconds. At the end of each trial the number of pegs were counted and recorded, and the board was left in the subject's view. The other board was placed in front of him and he was asked, "How many do you think you can put in this time? You will have the same amount of time before I call *Stop*."

There were five such trials, each of 20 seconds duration. For each trial both the achievement score (number of pegs placed in the 20-second interval) and the level of aspiration (the number of pegs the child said he could place on the following trial) were recorded. The wording of the instructions and the technique of leaving the board with the previous performance in full view of the subject were designed so as to obtain the child's realistic evaluation of what he could do, rather than a wishful estimate of what he would like to do.

Results

The initial problem was to determine whether there was a significant difference between the three groups in the over-all height of their level of aspiration. The measure used was the discrepancy score which was obtained by subtracting the number of pegs placed on a given trial from the subsequent estimate of the number the subject thought he could place —i.e., subtracting the achievement score from the subsequent level of aspiration. Since there were five trials, each subject had five discrepancy scores. The mean discrepancy scores for all five trials for each of the three groups ($N = 12$) are as follows:

Non-Handicapped	*Moderately Handicapped*	*Severely Handicapped*
1.93	1.98	1.18

An analysis of variance was done and an F of 1.43 was obtained. Since an F of 3.30 is necessary for significance at the .05 level of confidence, one can conclude that there is no significant difference between the mean discrepancy scores for the three groups. This means that there is no general

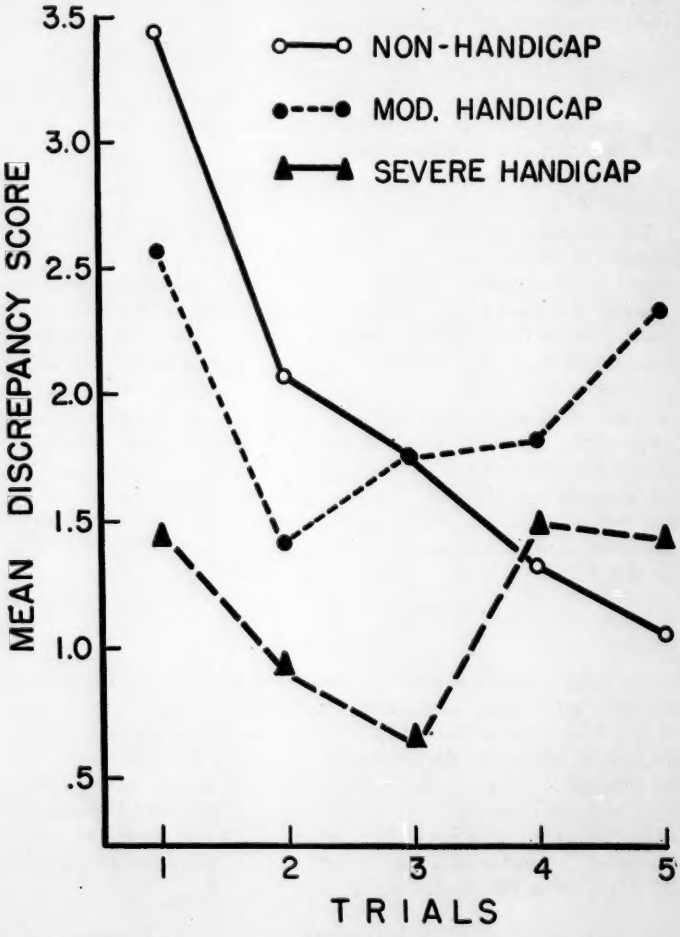

FIGURE 1—Mean discrepancy score on each trial for Non-Handicapped, Moderately Handicapped, and Severely Handicapped groups.

tendency for handicapped children to set consistently higher or lower goals for themselves than non-handicapped children.

However, inspection of the data indicated that the pattern of change in discrepancy scores from the first to the fifth trial might be different for the three groups. Therefore the mean discrepancy score for each of the five trials was obtained and were plotted on Figure 1.

A trend analysis was run and an F of 2.31 was obtained, which is significant at the .03 level of confidence. Thus there is a significant difference between non-handicapped and handicapped children in the goals they set for themselves as they continue working at a task. The non-handicapped group starts with high goals relative to achievement and gradually decreases this discrepancy as the task is repeated. The handicapped groups are characterized by (*a*) a systematic decrease in the initial height of the goal as the handicap becomes more severe, and (*b*) after an initial decrease in the discrepancy between achievement and performance, a reversal of the trend toward setting higher goals as the task is repeated.

Before discussing the meaning of these results and how realistic such goal setting behavior is, the actual achievement scores for the three groups must be examined since there is no reason to assume equal facility in performing the task. In order to obtain a general measure of improvement with practice, the number of pegs on the first trial was subtracted from the number on the last trial and group means were calculated. These means are as follows:

Non-Handicapped	*Moderately Handicapped*	*Severely Handicapped*
2.58	0.67	0.58

An analysis of variance yielded an F of 16.06, which is significant at the .01 level of confidence. Thus, non-handicapped children improve with practice to a significantly greater degree than handicapped children, whose over-all improvement is relatively small.

In order to obtain a picture of change in performance from trial to trial the mean achievement score on each trial was calculated for each of the three groups. These means are presented in Table 1.

The pattern of achievement is quite different for the three groups. For the non-handicapped children there is a dramatic initial improvement followed by a rapid deceleration. For the moderately handicapped children the improvement is very slow and difficult. For the severely handicapped children the achievement pattern is erratic and unpredictable, with improvement followed by poor performance.

Discussion

The two aspects of the present findings which will be discussed are (*a*) the initial difference in discrepancy scores of the three groups reflecting the

TABLE 1

MEAN ACHIEVEMENT SCORES FOR TRIALS 1 THROUGH 5 FOR NON-HANDICAPPED, MODERATELY HANDICAPPED AND SEVERELY HANDICAPPED GROUPS

Trials	*Non-Handicapped*	*Moderately Handicapped*	*Severely Handicapped*
1	13.50	9.16	2.83
2	15.41	9.41	3.16
3	15.41	9.75	3.66
4	16.08	9.83	2.91
5	16.00	9.83	3.41

fact that the level of aspiration was progressively lowered as the severity of handicap increased; and (*b*) the progressive lowering of the discrepancy score on the part of the non-handicapped group as the task was repeated, in contrast to the initial lowering and subsequent raising of the discrepancy scores on the part of the handicapped groups. The primary emphasis will be on the question of how realistic such patterns of goal setting are. In general, the discussion will follow Lewin, Dembo, Festinger, and Sears (2, pp. 333-378), who regard level of aspiration as the product of the desires to seek success and avoid failure, plus such factors as the subject's evaluation of his abilities, the nature of the task itself, group standards of performance, etc. The desires to seek success and avoid failure can be considered as motivational factors, while the remaining can be considered cognitive factors.

In regard to (*a*), it is not necessary to assume a difference in motivation in the three groups. This is because there is an important cognitive difference resulting from the difference in abilities of the groups. An improvement of two pegs is well within the realm of possibility for the non-handicapped child, but would be extremely difficult or impossible for the handicapped one. Experimental evidence (1) indicates that, when faced with a difficulty continuum, the individual will set up goals near the boundaries of his abilities. Since such boundaries are much more limited for the handicapped child, it is reasonable for him to lower his initial level of aspiration. Expressed in another way, it would be highly unrealistic for the handicapped child, with his limited abilities, to aspire to achieve to the same degree as the non-handicapped child. Thus, the initial lowering of discrepancy scores with increased handicap can be accounted for in terms of a realistic limiting of goals in keeping with diminished ability to achieve.

In regard to (*b*), the progressive lowering of the discrepancy scores on the part of the non-handicapped child indicates a realistic adjustment

to a task in which improved performance becomes progressively more difficult. However, the handicapped children seem to be able to maintain the realistic lowering of discrepancy scores only for a limited time, after which there is an increased disparity between what they actually achieve and what they aspire to do. This finding is all the more striking when one considers that, in reality, they can improve very little and, on this basis, should become more conservative in their estimates of future performance. There is experimental evidence (3) that such a phenomenon is seen in the case of children who in their daily lives are often unsuccessful in achieving what they set out to do. According to Lewin *et. al.*, such repeated failure leads to emotionality and unrealistic attitudes. In the present study, the handicapped children not only failed to attain their initial goals but, unlike the non-handicapped children, failed to improve the level of their performance significantly. One can speculate that it is the frustration of slow, minimal improvement or erratic, unpredictable performance which increases the emotional tension and gives rise to a more unrealistic attitude. It is also possible that the handicapped children bring to the task a longer history of past failures and performance under the pressure of cumulated frustrations. In this regard a level of aspiration study using a non-motor task would make an interesting comparison study.

Although there is good reason for describing the increase in discrepancy scores on the part of the handicapped children as unrealistic, it is impossible to determine what psychological attitude accompanies this change. With non-handicapped children it has been shown that such behavior goes along with feelings of dissatisfaction with status and lower self-confidence. Whether this is true of handicapped children can be determined only by further investigation. Perhaps the most conservative speculation is that the change is from a realistic to a wishful attitude. Initially the handicapped child can maintain the realistic attitude of trying to keep his goal in line with his achievement; but, under frustration of his limited or unpredictable achievement he comes to think in terms of how well he would like to do.

Summary

In order to determine the effect of a motor handicap on setting goals of achievement, 12 non-handicapped, 12 moderately handicapped, and 12 severely handicapped children were given a level of aspiration task involving five trials of putting pegs in a pegboard. There was no significant tendency for the handicapped groups to set higher or lower goals for themselves when all five trials were combined. However, there was a significant change in pattern of goal setting from trial to trial, the non-handicapped group progressively lowered their level of aspiration, in contrast to an initial lowering followed by a reversal toward setting higher goals as the task was continued on the part of the handicapped groups. This was

interpreted as meaning that, when faced with a motor task, the handicapped child can maintain a realistic attitude toward his capabilities for only a limited period of time; then, under the pressure of the frustrations of limited or unpredictable achievement, his attitude changes to a wishful one of what he would like to be able to do rather than what he is capable of doing.

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DEVELOPMENTAL TRENDS IN THE ABSTRACTION ABILITY OF CHILDREN[1]

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Abstraction is "a mental process in which some attribute or characteristic is observed independently of other characteristics of an experience as a whole." Werner (26) emphasizes that the ability to abstract does not appear suddenly in the course of the individual's development; rather it is present from the very beginnings of life but changes qualitatively with progress in maturation.

Different organizational patterns of response to environmental stimuli are observed in children of varying age levels (26). The abstraction behavior of very young children seems to be primarily on a sensori-motor level and can be designated as *perceptual.* In such a response the individual yields to demands of the situation, and the organization of the material is determined by the nature of the stimuli as well as by the limited maturity of the subject. A more mature individual would be expected to consciously impose organization on the material (1, 7, 14, 17, 19, 26) and classify the material into deliberately conceived categories. This is the *conceptual* level of abstraction.

The hypothesis that the younger the child, the more perceptual are his organizations has been stated (1, 7, 14, 26) but a search for specific details of the development encounters a paucity of data. The present study was undertaken to obtain information regarding changes in abstraction ability during the elementary school period.

PROCEDURE

Candidates for study were boys of lower-middle-class background who were in the correct grades for their ages and whose percentile ranks on the Raven Test of Progressive Matrices were between 25 and 75. From candidates 7, 9, and 11 years old, 20 were chosen at random to represent each age group.

[1] The data for this paper were contained in a dissertation presented in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Committee on Human Development, University of Chicago. The author wishes to express his gratitude to Drs. Helen L. Koch, Benjamin Bloom, and Robert T. Havighurst for their consistent encouragement in this research.

Toy objects were selected as the basic item for the grouping tests, and pilot exploration resulted in assembly of 24 items which were familiar to all of the children. Except for the snake, which was about 12 inches long, the maximum dimension of any object was 5 inches. The following objects were used:

1. Blue and red plastic lounge chair
2. Red plastic office chair
3. Brown and white plastic arm chair
4. Red plastic stool
5. White plastic dining table
6. Red plastic end table
7. Plastic man in black suit and white shirt
8. Plastic woman in blue dress
9. Flesh pink rubber baby doll
10. Flesh pink celluloid child doll
11. Brown metal soldier
12. Metal boy in blue suit
13. Green plastic truck
14. Blue plastic baby carriage
15. Purple plastic airplane
16. Red and yellow plastic tractor
17. Blue metal train engine
18. Red and blue plastic boat
19. Brown metal chicken
20. Red celluloid fish
21. Pink celluloid duck
22. Red plastic horse
23. Green wood snake
24. Black and white plastic dog

Five variants of the test situation were used:

Form I—Tactual-motor. The subject was permitted to handle the objects while making his groupings.

Form II—Visual-non-motor. The subject was not allowed to touch the objects but was asked to point to or name the objects and instruct the tester on grouping.

Form III—Pictures. Black and white photographs mounted on cards approximately 3.5 × 4.5 inches were substituted for the objects, and the subject was allowed to group the cards manually.

Form IV—Names. The name of each object was printed in large, black block letters on a card approximately 3 inches square, and the subject was asked to group the cards.

Form V—Names listed. The names of all objects were typewritten on the upper one-half of a sheet 11 × 13 inches, and the subject was asked to write the names in groups on the lower one-half of the sheet.

Within each age group the order in which the five forms were given was rotated so that four subjects of the twenty did Form I first, four did Form II first, etc. In the presentation of each form the materials were arranged in a circle on a table so that two objects obviously of the same class were not adjacent. The same arrangement of materials was employed with all subjects.

Before testing, each child was asked to identify the objects as they were placed on the table or to read the names on cards as listed. Before each test a subject was told to "put those things together in a pile (or list) that belong together or go together or are alike in any way, and those other things that go together or belong together or are alike in another way in another pile (or list). You may have as many or as few piles as you wish. Do you understand?" Some seven-year-olds found the concept of "belongingness" or "likeness" difficult to grasp. Examples were not given because they might set a pattern and deter spontaneous grouping. When a child seemed not to understand or asked whether there was a right way to group, the directions were repeated. Judged by the performances of the children, the task was comprehended.

Minimum control was exerted by the experimenter in the first test situation, the child being left to determine what made things similar or belong together. Trials were completed in not more than ten minutes. After completion of the first trial, a subject was asked to explain the reason for each group. The names of objects in each classification and the reasons for groups were recorded *verbatim*. To determine the upper limits of grouping and the effects of pressure, additional trials were used.[2] Each child was instructed to "group the things that are alike or belong together into fewer groupings than you made the first time," until the children could not reduce the number of groupings. After the objects were grouped, the reasons for grouping again were recorded *verbatim*. Identical procedure was followed with each of the five test forms. Each child was given one test daily for five consecutive days to reduce fatigue and perseveration.

Upon completion of the five test forms, each subject was given a class recognition test to determine his ability to recognize bases of groupings possibly more inclusive than any he had devised. Successively, a child was introduced to the groups of objects which could be classified as animal, human, vehicle, and furniture and was asked, "Do these things go together or belong together or are they alike in any way?" If these were identified, the experimenter presented to the child the 24 objects in two groups, those "living" and "non-living," and asked the same question. If these were identified, the 24 objects were placed in a single group, and the child asked the basis of it. Finally, the subject was exposed to the classifications "red" (office chair, stool, horse, fish, end-table) and "metal" (train engine, soldier, boy, chicken).

For scoring on the basis of the number of objects placed in each category, designations of groupings were classified as perceptual, conceptual, and miscellaneous; sub-categories were required for the first and last of the three classifications. The designations are similar to those used by Bolles (1), Goldstein and Scheerer (7), and Werner (26).

[2] The first and second trials were only used for analysis since too few children in the sample were able to reduce the groupings in Trial 3.

A. *Perceptual*

1. *Affective*—grouping based on feeling.
2. *Identity*—grouping based on identity of structure or function.
3. *Partial Identity*—grouping based on identity of certain aspects of structure or function.
4. *Centroid*—grouping based on belongingness in a geographical area.
5. *Functional*—grouping based on use.

B. *Conceptual*—grouping in which the objects were treated as members of a class even though gross structural differences were apparent. Designation by a class name was required for a grouping to be scored conceptual.

C. *Miscellaneous*

1. *Mixed-1*—grouping in which conceptual and perceptual classifications are combined and treated as perceptual.
2. *Mixed-2*—grouping in which two or more perceptual groupings are combined into a third perceptual category.
3. *Thematic*—grouping based on a story.
4. *Pseudo*—grouping which appeared incorrect in interpretation or information of reality.
5. *Non-Groupings*—objects which were not found to belong to any grouping and which were isolated intentionally.

The miscellaneous categories were derived from a pilot study and are recognized as a heterogeneous combination of sub-categories necessary to demonstrate adaptations in sorting behavior when "pure" conceptual or "pure" perceptual organization was not exhibited.

Results

The frequency with which the children of three age groups made use of the perceptual and conceptual classifications in Trials 1 and 2 is shown in Figure 1. By an analysis of variance technique (4) the age differences indicated in the chart for conceptual classifications in Trial 1 were significant at the .01 level of confidence. Differences in the use of conceptual categories also were significant for every age comparison in Trial 2. The age differences in perceptual classification in Trial 1 were significant between the group of children 7 years old and both of the older groups but were not significant between groups 9 and 11 years old. In no instance were dependable differences found between tests (18).

Comparisons between Trials 1 and 2 for groups of children 7, 9, and 11 years old did not show significant changes in the use of perceptual

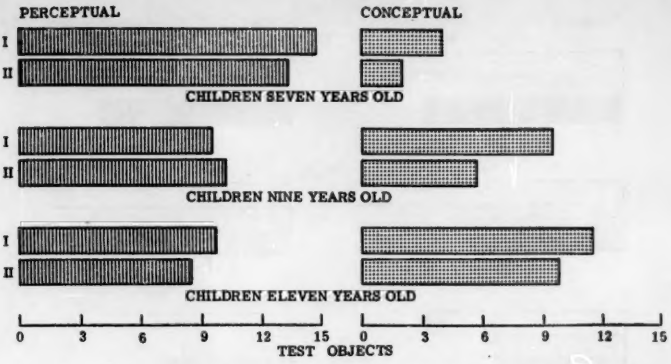

FIGURE 1—Comparisons of mean numbers of objects placed in perceptual and conceptual categories by children of three age groups.

type classifications although the direction of change was toward an increased use in Trial 2 by the nine-year-olds and decreased use by the other two groups. With respect to conceptual classifications all groups showed changes significant between the two trials at least at the .05 level of confidence. However, in both trials the trends with increasing age were similar downward for use of the perceptual categories and upward for the conceptual classifications.

The percentages of objects grouped according to the subcategories of the perceptual and miscellaneous[3] classifications are shown in Figure 2. The children never used the "affective" category and the "identity" category was omitted because with the test objects employed, identity might have been a conceptual approach in some instances and a perceptual approach in others.[4]

In both trials the children 7 and 11 years old employed the partial identity category as a basis of grouping significantly more than did the nine-year-old children. Similarity is apparent between the results for seven- and eleven-year-old groups, yet one would expect to find differences, since maturity is a factor in differentiating the types of classificatory approaches used. If the reasons offered for the groupings are considered, the seven-year-olds classified significantly more frequently on the basis of partial identity of action than did the nine- and eleven-year-olds. The two older groups

[3] It was felt that in view of the heterogeneity of the miscellaneous category, it would not be valid at this time to treat them as a single unit. Analysis of these results, however, will be presented later.

[4] Nevertheless, the use of what might be considered "identity" was rare. This might have been a function of the materials, since no two objects were identical.

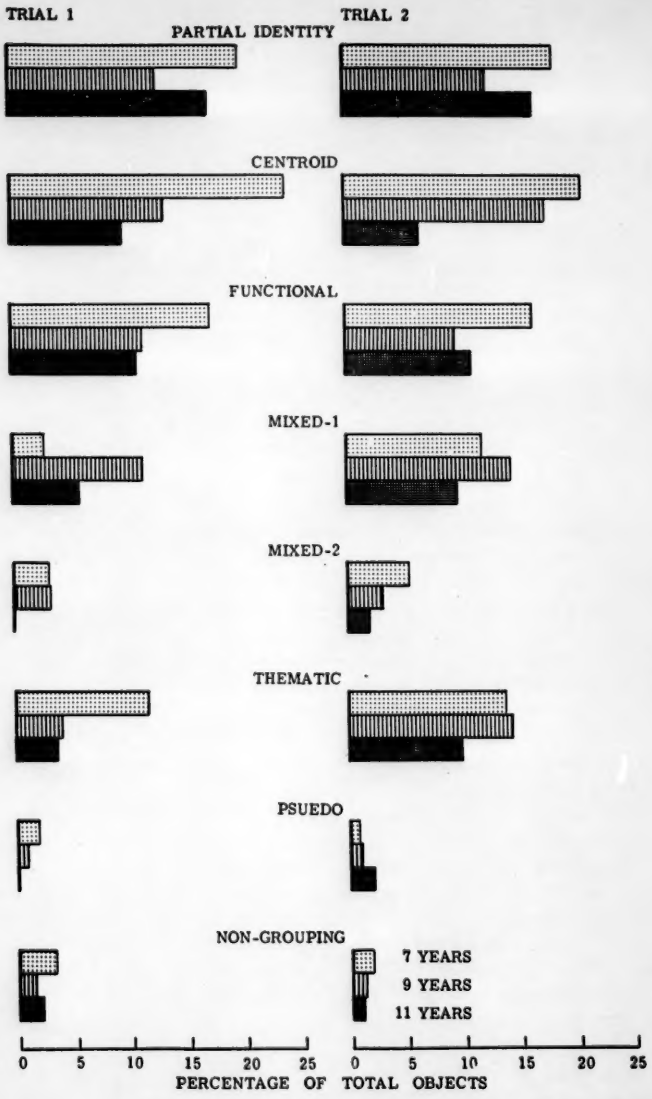

FIGURE 2—Comparisons of percentages of total number of objects placed in perceptual and miscellaneous categories in Trials 1 and 2 by children of three age groups.

tended to use partial identity of structure, although the differences between the nine- and eleven-year-olds is not significant. Partial identity of structure was used significantly more by the eleven-year-olds than by the seven-year-olds.

The centroid grouping was employed by the youngest children more significantly and use of that category was less for each older age group. Typical reasons given for the groupings were: "all belong in air," and "all belong in the house." Objects were organized in ways familiar to the child from his own experience or from stories and explanations. The trend described occurred in Trial 2 also, although the nine-year-old children increased their use of this type of classification.

The seven-year-old children also employed functional grouping significantly more than did the older children. Nine- and eleven-year-old children used the category almost equally. Under pressure to reduce the groupings, the eleven-year-olds increased the frequency of their use of this classification but the other two groups did not.

Examination of the uses of the miscellaneous groupings shows that in the first trial the combining of the perceptual and conceptual approaches (mixed-1) occurred most frequently among nine-year-old children. The combination of two or more perceptual categories (mixed-2) was used almost equally by the seven- and nine-year-olds, but rarely by the older children. In Trial 2, however, all groups increased their use of the mixed categories, the greatest increase being for the oldest children.

Use of the thematic category decreased with age, the seven-year-old group using it most frequently. In Trial 2, however, the nine-year-old children increased their use of this approach to an extent that results for the seven- and nine-year-old groups do not differ significantly. The eleven-year-old children also increased their use of thematic groupings in Trial 2.

Subsumed under the category "pseudo" are the groupings meaningless to us. This and "non-grouping" appeared rarely and most frequently in the seven-year-old group. The children had the most difficulty with the category "vehicle," which some did not use at all. More frequently, the failure involved only the baby buggy. Even eleven-year-old children often did not think of this classification. The difficulty may have stemmed from the fact that baby buggies have no motors as do the other vehicles represented. Another possibility is that the children may have considered it part of the family's furniture. The boat, the snake, and the fish also presented difficulties and frequently were left ungrouped, especially by the seven-year-old children.

The question arises, can the child who does not in spontaneous groupings use such categories as animal, vehicle, furniture, human, redness, and metal, identify such classfications when the groupings are made by the experimenter? The results of the recognition test are summarized in Table 1 and demonstrate that the ability to identify groupings increases with age.

TABLE 1

PERCENTAGES OF GROUPS OF CHILDREN WHO IDENTIFIED GROUPINGS IN RECOGNITION TEST

Groupings	*Age Groups* (years) 7	9	11
Animal	50	75	90
Human	60	85	95
Vehicle	0	40	50
Furniture	40	90	90
Living	0	40	35
Non-living	0	15	15
Single Group	0	0	25
Red	5	20	10
Metal	0	0	10

The similarity between scores of the nine- and eleven-year-old children is greater than between those of either group and the seven-year-old children. Only the nine- and eleven-year-old youngsters were able to identify the category "living things" and only eleven-year-old children were able to give some adequate reason for grouping all the objects into one category. More of the nine-year-old group were able to identify the "red" category than either of the other two age groups. Only two eleven-year-old subjects were able to identify "metal" as a basis of classification, perhaps because the metal objects were painted. All children gave some basis for their designations of the groupings, but their reasons were not always correct in terms of conceptual response. Usually, the explanations were not different from those offered for their own classifications.

DISCUSSION

The classificatory behavior represented in the first trial indicates the child's ability in a situation which is minimally structured. The children were free to use the approaches they "felt most comfortable" with in determining similarity or belongingness. The trends are clear cut that regardless of the nature of the material, perceptual classifications declined and conceptual ones increased with age. This finding substantiates the hypothesis that with increases in age significant changes in classificatory behavior occur. The specific determinants effecting this change are difficult to isolate. Although the group trends reported are clear cut, individual variations within the groups in the use of "more mature" classificatory approaches were found. Some seven-year-olds were able to utilize conceptual as well as

perceptual approaches. What accounts for the individual variations becomes a highly relevant and pertinent question. Since chronological age and social class are controlled, and since the mental ability range within the groups did not include extremes, the questions point to areas of experiential, personality and organic forces as possible determinants of the difference. Factors such as quality of experience with similar problems, early learnings of concepts, reality "boundness," and rate of constitutional maturation offer themselves as possible determinants of the variations observed. Further experimentation with variables such as these is necessary.

Whatever the reason, the results of this study tend to confirm those reported in the literature (1, 7, 15, 19, 21, 26). The various uses made of the sub-categories is an important consideration. The total perceptual score is a composite of all the perceptual sub-categories. Hence, to state that perceptual classifications decrease with age is merely a half truth. Examination of the perceptual sub-classifications reveals significant differences in the frequencies with which they were used. Partial identity was used by the two youngest age groups with about the same frequency. The results, however, differ qualitatively in a way that tends to confirm the view of Werner (26) and Koffka (12) that action and movement are abstracted earlier than structural aspects. Thus, this quality is a significant indicator of maturity differences. The seven-year-old child, perhaps since his early experiences with objects are in terms of movement, has not yet replaced this more primitive learning with that which is more sophisticated. The question also arises as to the relationship between partial identity of structure and conceptual classificatory ability. It is the oldest group, the one in our population most able to handle the material conceptually, that tends to use this approach. Is the structural approach intrinsic to or correlated with conceptual thought? It may be that the two are interdependent.

Similarly, in the centroid grouping the specification of location as a determinant of belongingness or similarity emphasizes the more concrete nature of the younger children and indicates inability to perceive the materials in the "abstract," that is, not tied to specific places or persons. That this approach declines so sytematically with age would support this premise. The same thinking holds with respect to the functional approach. The inability to see objects as representing classes of material; rather, the perception of them as similar by virtue of utility is further evidence of concreteness.

It is not surprising that seven-year-old children have difficulty in using the mixed-1 category frequently, for use of this approach is correlated with the ability to use the conceptual category. By definition, children could not be expected to use mixed-1 with any greater frequency than they were able to use the conceptual category. Of interest, however, is the frequency with which the nine-year-old children used this approach. Figure 2 indicates their preference for a combined approach in at least one conceptual category.

This suggests that not being quite ready to see the objects only as member components of a class of objects, they prefer to associate the objects with something concrete, thereby adding the perceptual concept to the classification. It is clear that mixed-2 is used infrequently by this group and the eleven-year-olds have no need to use the approach at all.

The rationale of using additional trials to indicate the extent of approach and, to some degree, the stability as well as the solution to a more complex request for grouping was substantiated by examining the shifts that did take place.

The changes that occurred in the second trial reflect the children's ability to reorganize their groupings in new ways. Some of the children included more objects within the groupings which they had already established. For example, a seven-year-old child who in Trial 1 made three centroid groupings, in Trial 2 merely brought them together into one centroid group. The idea used to explain the grouping was enlarged in scope and inclusiveness, but the type of grouping remained the same. This did not actually involve a shifting of the basis of the groupings, for the child did not select a new classificatory scheme by which more objects could be included. The child could shift within narrow limits, for he had to reorient the classificatory scheme applied to the objects, but he was not able to find an essentially different basis for groupings.

Some children were able to shift from perceptual to conceptual classifications, which involved utilization of classifications essentially different from those used in the previous organization. For instance, one change was from a grouping in which animals were placed together "because they live on a farm" to a grouping of the animals "because they are animals." The type of shifting involved in this situation requires a greater degree of flexibility than is required in the example cited previously, a reorientation of "attitude" toward the objects to perceive them in a basically different way. This ability to shift from perception to conception is evidence that a child is well established in the use of the categorical approach.

In Trial 1, one seven-year child made four groupings: (1) the fish, the snake, the duck, and the boat, "because they all belong in water" (scored centroid); (2) the boy, the man, the woman, the soldier, the doll, and the baby, "because they are all people" (scored conceptual); (3) the tractor, the truck, the plane, the train, "because they all run and run on the ground" (scored mixed-2); and (4) the horse, the dog, the chicken, "because they all walk" (scored partial identity). In Trial 2 he made three groupings: (1) the vehicles, except the baby carriage, "because they are all things you travel with" (scored functional); (2) all the animals "because they are animals" (scored conceptual); and (3) the furniture and the people "because people sit and use the furniture" (scored mixed-1). This record clearly shows shifting from the original approach and the inclusion of a new conceptual category not used in Trial 1. It is true that the child used a conceptual

classification in the first trial, which might be related to his ability to make another conceptual grouping in Trial 2 and bring all the animals into one group regardless of differences in structure. He did not alter his original conceptual grouping, but to make fewer groupings, as directed, he had to group humans and furniture together in a mixed category.

Such findings indicate that individual differences in ability to handle some types of material conceptually and to shift are found as early as the seventh year. Whether vocabulary, unique experience favoring concept formation, certain types of innate ability, maturational factors, or personality determinants affect the abilities of the youngsters is still an open question.

Principally, shifting by the nine- and eleven-year-old children was toward combining classificatory types. The general trend was toward fewer items grouped conceptually and more items grouped in miscellaneous categories. However, nine-year-old children were able to expand their conceptual groupings in Trial 2 by changing to animals or to humans from centroid categories. The Raven scores of children able to effect these changes ranged from the 50th to the 75th percentile.

Only one eleven-year-old child, whose Raven score was around the seventy-fifth percentile, grouped all of the objects into one category "because God created all these." Although performance of this level is rare, it is significant that eleven-year-olds shifted from perceptual to conceptual approaches with greater frequency than did seven-year-olds. The fact that many of the children were unable to make fewer groupings in Trial 2 than in Trial 1 indicates a type of rigidity, a kind of "boundness" to the already achieved tasks. Our justification for qualifying rigidity is simply that we are using a limited measure of rigidity or flexibility, i.e., rigidity with respect to number of groupings. If we had asked that the children merely alter the groupings, without requesting change in number of groups, more intensive rigidity might have been detected. The two types of shifting described indicate that a reorientation in approach toward objects occurs as early as age seven. Developmentally the trend from shifting within a single approach to shifting from one classificatory scheme to another may well be a key to the maturity index of conceptual thinking. The seven-year-old who can do this, therefore, is more mature in his abstraction ability than the seven-year-old who cannot, if maturity be considered in terms of the degree of similarity of performance from the young to the older. It would be interesting and fruitful to explore this question further by finding out if such differences relate to language ability or problem solving ability.

The findings of the "Recognition Test" show interesting agreement with those of Welch (23), who tested the ability of children to learn certain abstract concepts rather than the frequency in the use of the concepts.

The recognition test showed that the use of hierarchic levels in grouping material increases steadily with age. The designation *conceptual* in this study actually was applied to groupings which Welch would have called

second level—the "animal," "human," "vehicle," and "furniture" categories. The categories "living" and "non-living" are third level and "substance" is fourth level in Welch's system.

We have pointed out the difficulties seven-year-old subjects had in identifying even second level concepts, as well as their inability to identify third and fourth level ones. Although results of the study showed definite changes with age in the ability of children to identify groupings, the problem remains of explaining why certain groupings are more readily identified than others. The effects of qualitative differences in experience upon the formation of concepts needs further analysis.

Summary

Sixty white lower-middle-class children, 20 from age group 7, 9, and 11 years, who were in the correct grades for their age and whose percentile rank scores on the Raven Test of Progressive Matrices ranged from the 25th to 75th percentile, were selected as subjects. To each child five test situations, each containing 24 familiar toy objects, pictures of these toys, and word names of the toys were presented. They were instructed to group materials on the basis of similarity.

The data presented reveal a decrease with age in perceptual classification of items. This decrease between the ages of 7 and 9 years was significant, but not between 9 and 11, when children were asked to reduce groupings. The use of conceptual classifications increased steadily with age. Placement of items in miscellaneous categories was negatively correlated with age when the children were allowed free choice in grouping, but when urged to reduce the number of groupings, an age trend was not found.

Seven-year-old children principally used groupings of the thematic type in their first trials and repeated that approach when requested to reduce the number of groupings.

Nine-year-old children tended to use conceptual and perceptual classifications equally and made some use of the miscellaneous categories as well. When requested to reduce the number of groupings, they increased perceptual and miscellaneous classifications and reduced conceptual groupings.

Eleven-year-old children employed conceptual groupings predominantly but used the perceptual approach about as frequently as did nine-year-old youngsters. Miscellaneous classifications were infrequent when grouping was spontaneous. With pressure to reduce the number of groupings, conceptual and perceptual classifications still were used, but recourse to the miscellaneous category increased.

When groupings of the objects were made by the experimenter, the chidren's effort to identify the bases he had in mind did not reveal essentially different patterns of thought than did the groupings made by the children themselves.

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CONVERGENCE: AN ACCELERATED LONGITUDINAL APPROACH

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The problems involved in cross-sectional and longitudinal studies suggest the desirability of emphasizing the need for more extensive use of a third method. Essential features of this method are discussed in this article.

THE LONGITUDINAL APPROACH

Despite the many well-known advantages of the longitudinal approach, which have been described by Anderson (2) and others, Jones and Bayley (4) have pointed out that very few research centers are making a systematic use of this approach in studies of human development. The difficulty of financing and managing such projects engenders much hesitancy in both the investigators considering the task and the prospective supporting foundation or agency. The investigators need to consider carefully whether their own life plans are compatible with the experimental plan since cooperation of the group studied is difficult to maintain with frequent shifts in personnel. The large expenditure involved leads to prolonged negotiations and extensive planning periods. In addition, the magnitude of the expenditure may result in a tendency of the investigators to attempt to gather entirely too much data. This compulsion to collect measurements on all possible variables could be a function of the feeling that later results may turn up promising leads for which necessary substantiating data were not gathered in earlier periods. It may also emanate from a feeling that for such expenditures of money and effort only complete comprehensiveness is acceptable. Such a view would be consistent with a belief in the importance of basic data accumulation at a given phase in the development of a field. In any event, theory construction and precise testing of hypotheses are less frequent than data amassing operations.

In addition to the above problems, long-term longitudinal studies present many methodological difficulties which restrict their utility. The necessary sampling selection involved in restricting a study to cooperative groups limits generalization of findings as Anastasi and Foley point out (1, p. 268). It must be considered also that sampling errors made in the original selection are perpetuated in the continuing study, except to the extent that loss of cases due to death, migration, and other factors, changes the fundamental characteristics of the original sample still further. Another problem is that the repeated contacts and measurements necessary in some projects may lead to concern that the observation has itself introduced important changes

in the orientation and motivation of the subjects. This seems less important in an area such as the study of growth curves, for example, than in a field such as child rearing practices. Still further complications arise from the fact that new and improved measurement techniques as well as important new variables may appear which cannot well be incorporated in the experimental plan. In short, it is apparent that the longitudinal approach is not the method par excellence for studying human development. A longitudinal approach should be selected, as any other method, on the basis of its appropriateness to the problem at hand. The problem is when to apply the longitudinal method, rather than how to marshal the courage to face the task.

The Cross-Sectional Approach

The cross-sectional approach offers certain advantages over the longitudinal, where contamination due to repeated observation is a matter of concern. At the same time, measurement techniques and variables to be studied are adjusted to the current level of scientific development. The investigator may feel more inclined to measure a few variables precisely or test definite hypotheses. Results from this type of study suggest new hypotheses which can be tested in further studies adequately designed for the purpose. Thus the development of a theoretical model in the area concerned moves much more rapidly than would be the case in a longitudinal approach in which the hypotheses are developed over a long period of time and cannot be tested adequately within the framework of the study as originally formulated. The possibility remains, in the case of cross-sectional approaches, that observed changes in age groups are a function of differences other than age between groups studied. The "dropping out" phenomenon, which makes successive school grade groups differ in representativeness of the basic age populations in the sampling universe, frequently seems adequate to account both for the direction and extent of changes observed in cross-sectional studies. In other cases, as Kuhlen (5) has pointed out, social change creates different experiential backgrounds for different age groups.

In any study where the cumulative effect of an independent variable on an individual is desired, a longitudinal approach must be used. For example, if one were to study long-term effects of annual guidance and counseling for school children, a cross-sectional approach could not be used.

Acceleration of the Longitudinal Approach

It is the purpose of this paper to suggest more extensive use of a research technique other than the cross-sectional or longitudinal in order to deal with some of the shortcomings of both. To facilitate presentation of the technique, it will be referred to as a convergence approach. It involves combin-

ing the cross-sectional and longitudinal techniques in such a way that developmental changes for a long period may be estimated in a much shorter period. Cross-sectional studies are made of different age groups so spaced in age that remeasurement of the same groups after a period of time provides information on the nature of the changes occurring over the entire age period, as well as data which will permit an answer to the question of whether the shorter curves for each age span may reasonably be combined into a curve covering the entire age period.

For example, a study of changes in a dependent variable such as synonym usage in children's word definitions over a four-year period may be accomplished by measuring each of two age groups three times over a two-year period. Age groups such as eight- and ten-year-olds would be selected so that the final measurement of the eight-year-olds is made at the same age as the initial measurement of the ten-year-olds. If the changes in frequency within each group showed continuity with the changes in the other group, and the frequency at age ten was essentially the same for both groups, the change in usage from the initial measurement of the eight-year-olds to the final measurement of the ten-year-olds could be defended as representative of a curve which would have been obtained had a single group been measured over a time span of four years.

The utility of the principle underlying this technique has been pointed out by Kuhlen (5). Miles (6) was able to show that sampling differences alone could not account for a decline in intelligence test scores shown in a cross-sectional study of four different age groups. A similar decline was revealed in remeasurement of the original age groups.

Application to single variable studies. An illustration of an application of this approach to a study of a single variable over a relatively long time period may be provided by assuming that an investigator wishes to study changes in variable *X* for children age six to fourteen. The curve plotted with triangular points in Figure 1 might be considered the "true curve" for the entire age period. Measurement of the dependent variable in year one of the study for children in the age groups six, eight, ten, and twelve (groups A, B, C, and D), followed by the remeasurement of the same groups in years two and three, would yield twelve points on the over-all curve, three for each age group. Plotting of these points on the same graph would possibly indicate that the slopes of the lines connecting points within adjacent age groups were essentially equivalent. This is illustrated by the curve shown for example I, plotted with open circle points.

If separate curves as shown for example II were obtained, the investigator might have reason to question the hypothesis that each age group was a sample of the same basic population universe, subject to age change only. In effect, within a two-year period with three measurements on each age group, the investigator would be attempting to construct a curve for an eight-year period.

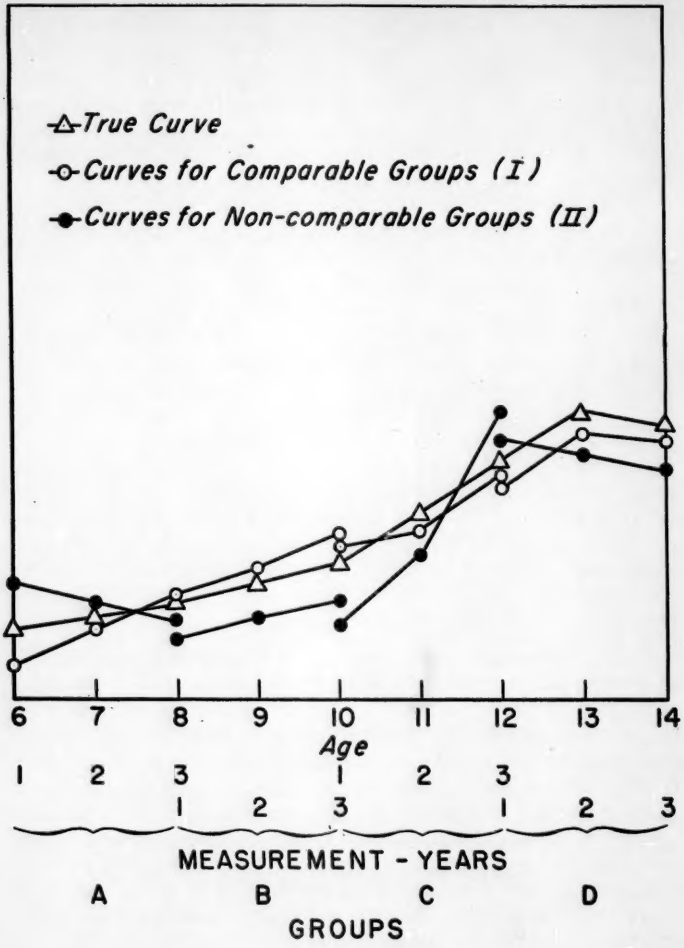

FIGURE 1—Hypothetical Growth Curves for Comparable and Non-Comparable Groups

In the case of example I, the investigator might well argue for the essential comparability of his age group sampling. It is more likely that group B had a curve between six and eight similar to group A than would have

been the case had the two groups at age eight been moving either in different directions or were at different levels, as is the case of example II.

The two age groups A and B in example I have converged statistically. This convergence would favor the notion that the groups are comparable for the purpose at hand, and the investigator has some support for the operation of linking the curves. In so doing he is considering the measurements of groups A and B as representative of those which would be yielded by a single group over a four-year period.

Significance tests may be applied to the difference between group A and B means at age eight. Evaluation of direction of movement is more difficult. A forward extrapolation of group A means is to be compared with the curve defined by group B means, and a backward extrapolation of group B means is to be compared with a curve defined by group A means. The writer is not aware of any technique which could be used here other than inspection, unless group A, for example, were to be measured again at age nine so as to overlap with two measurements on group B. In the latter case an application of analysis of variance would seem appropriate to test the significance of the difference between the means of the two groups on two different measurements.

It is most likely that the evaluation of direction of movement would have precedence over comparability with respect to levels in determining whether the curves should be linked. Thus the fact that there might be a significant difference between group A and B means at age eight in example II of Figure 1 would carry less weight than the difference in direction of the two group curves. If group A and B means at age eight were identical and these were the only measurements available, the possibility might exist that the two groups reached this level from two quite different preceding curves. The possibility remains that the difference in direction of movement for the two groups is an evidence of discontinuity in the basic developmental variable rather than evidence of non-comparability of the two groups. In this example, however, the difference in levels might suggest sampling variation. If there were only a difference in direction of movement, the discontinuity hypothesis would be more tenable. In such a case a new study in which seven- and nine-year-olds are used as groups A and B would remove the curve-linking problem from the temporal vicinity of the suspected discontinuity.

Application to multiple variable studies. If several variables were to be studied in the investigation and measured in comparable units, the problem of determining whether measurements for adjacent groups should be linked is partially a question of whether the profiles for the two groups at the same age are similar in shape and level. This question of similar shapes can be answered by an analysis of variance test as advocated by Block *et al.* (3). The question of differences in level is the usual analysis of variance test for the significance of differences between groups on two or more

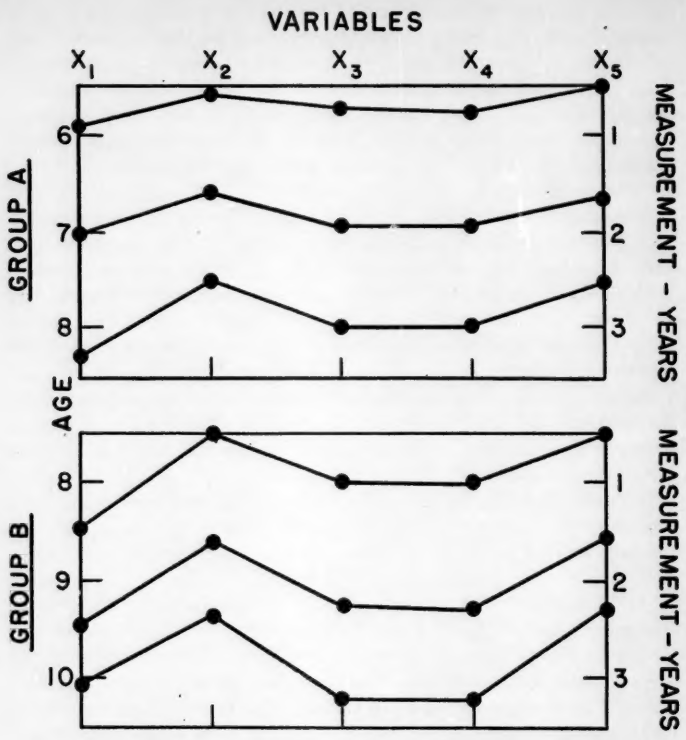

FIGURE 2—Hypothetical Profile Changes in Two Comparable Groups

measures. Again, the question of direction of movement would have to be dealt with either by inspection or creating overlapping measurements as indicated above for the single variable problem. Figure 2 is an attempt to represent a situation in which such evaluations would be involved. Variables $x_1 \ldots x_5$ are measured in standard score units in year one, two, and three, starting at age six in group A and age eight in group B. In this case the question is, in part, whether the profile of group A at age eight is significantly different in level and shape from the profile of group B at the same age. Comparability of the groups in this multivariate situation should give the investigator more confidence in the operation of linking curves than in the situation where only one variable is measured.

Average and individual curves. The illustrations given above assume essentially homogeneous groups. Such an assumption is frequently unwar-

ranted, as has been shown in instances where individual growth curves have been compared with group curves (7). It should be noted that repeated measurements of the same individuals in a longitudinal or convergence study offer a basis for identifying sub-groups within which developmental changes are relatively homogeneous. In cross-sectional studies there is no basis for identifying sub-groups of individuals whose measurements change in essentially the same manner with the passage of time. The fact that such sub-groups must be relatively large for their measurements to be stable requires that the parent group be quite large. Where these conditions can be met it would seem desirable in either a longitudinal or convergence study to attempt to link measurements of sub-groups rather than parent groups. Group A in the example of Figure 1 may actually be composed of sub-groups $A_1 \ldots A_n$ which could be linked developmentally with certain of the sub-groups $B_1 \ldots B_n$. The behavior of such sub-groups may be much more important than changes in the composite group.

The purpose of the above discussion has been to illustrate the essential elements of the convergence approach. Detailed consideration of statistical problems involved in specific applications is not appropriate in this context. Measurement issues such as the problems of difficulty range and equality of units will not be discussed since they are involved in all three types of developmental studies.

Summary

The convergence approach appears to have greatest utility in two types of situations: (*a*) in investigations basically oriented toward a cross-sectional approach but in which there is reason for concern over the comparability of the experimental groups relative to the dependent variable on factors other than age, and in which it is possible to make limited remeasurements of these groups; (*b*) for investigations oriented toward the longitudinal approach but faced with problems of transient or less cooperative groups or with possibilities of undesirable contamination of the experimental population by extensive observation.

It is expected that the desire to anticipate long-term trends as early as possible and the need to incorporate current research developments would favor use of the cross-sectional and convergence approaches. The desire to follow individual changes, when reformulated as a desire to identify and follow statistically meaningful sub-groups, does not preclude use of the convergence approach. If the cumulative effect of an independent variable on a single individual is to be studied, however, the convergence and cross-sectional approaches cannot be used.

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